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Effects of induced motion on the recall of threatening words as a function of anxiety

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Effects of induced motion on the recall of threatening words as a function of anxiety

by

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Abstract

Aim and contribution: The current study aimed to explore whether the use of a vection based intervention (induced motion) leads to improved memory of threat related material in high-trait anxious individuals. Considering evidence showing the importance of context-reinstatement for memory, the study's original contribution to knowledge is that this is the *first attempt* to examine this in relation to threat related material and anxiety.

Methods: Ninety students were allocated to three conditions of either watching a video depicting a train moving backward, or forward, or no video for the controls. The Spielberger trait-anxiety questionnaire (STAI) (Spielberger, 1983) was administrated to measure both state and trait anxiety. Following this, participants were required to memorise a list of 20 words, containing 10 threatening and 10 neutral words (Maddock, Buonocore, Kile, & Garrett, 2003). A distraction of 10 minutes duration was used in the form of Sudoku puzzles.

Results: No significant difference was found between free recall of threat related words or neutral words in high-trait anxious versus low anxious individuals, when experiencing vection-based intervention compared to controls. Bower's (1981) theory posits that the current mood of an individual affects his or her ability to encode and retrieve information. However, state anxiety did not increase over the course of the current experiment, which meant that at retrieval stage participants could not access their anxious mood in relation to threat words, which they might have felt at encoding stage. More research is needed to understand the relationship between context-reinstatement and memory bias in anxiety. Limitations and future directions are explored.

Keywords: vection, mental time travel, recall, temporal psychological distance, explicit memory, implicit memory, memory bias, episodic memory, anxiety disorders, threat, context-reinstatement.

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Overview

What motivated this research?

Grappling with anxiety is perhaps something that we all experience to some extent in our daily lives. As a counselling psychologist in training I aspire to contain and alleviate the client's anxiety as well as being in touch with my own process along the way. This has led me to the realisation that anxiety is something that I would like to know more about. Discovering that research has established links between memory and movement in time and space proved very interesting for me. This is called 'temporal Doppler effect' which refers to the tendency to perceive the future as psychologically closer than the past. It has been argued that this tendency is similar to the physical 'Doppler effect' in which there is a change in the perceived pitch of a sound as the source of that sound approaches the observer (Doppler, 1842). Furthermore, it has been shown that participants tend to focus more on the future when exposed to a sense of movement forward, and similarly, when presented with a sense of moving backward, they tend to focus more on the past compared to controls who were not exposed to any movement (Caruso, Boven, Chin, & Ward, 2013). Together with the notion of Doppler effect and its link to movement in space, as well as the findings of a recent manuscript in preparation which showed that a backward vection (i.e., the process of inducing perception or sensation of movement) enhanced recall of neutral words (Aksentijevic, 2017), has led me to the intriguing question of what impact virtual movement (i.e., forward or backward) has on free recall of threat related words in high-trait anxious individuals given that this will bring them back or forward in time psychologically.

Why I believe this topic is important?

This research study offered an opportunity to better understand memory bias in anxiety considering that there are no research studies to date that attempted to mentally bring back high-trait anxious individuals to the moment of encoding. Therefore, the rationale for the present study is to explore the possibility that some of this recall-relevant contextual information could be recaptured by psychologically transporting the participant back to the moment when they were first presented with it. Since this is a new area of research, its practical implications can not yet be determined. However, informed by my clinical practice, I would suggest that future research, which builds on this current study, could promote a better understanding of the relationship between memory and mental time travel. Specifically, this might help to alleviate anxiety in high-trait anxious individuals by counteracting avoidance and thus enabling a more objective processing of threat related stimuli. Furthermore, it may

help to improve memory and thus quality of life for patients with Dementia. Finally, it may help patients with trauma to re-process their traumatic memory in a more helpful way. Specifically, enabling patients with trauma to access the context of the memory might help as it is often the case that they re-experience intrusive sounds, smells and colours over and above the context in which the trauma took place. This happens due to a very active Amygdala (i.e., a part of the brain that is involved with experiencing emotions) and inactive Hippocampus (i.e., a part of the brain that is involved with processing memory).

Why is my research important to the field of counselling psychology?

Counselling psychology and psychotherapy in general can be viewed as being very much concerned with the experience of individuals, which is linked dynamically and intimately with memory. A better understanding of the relationship between memory and anxiety is vital for counselling psychology and psychotherapy in general because memories play a key role in the experience of emotional difficulties. The current study serves an important clinical and practical starting point for psychotherapy in general and counselling psychology in particular, since it draws new attention to motion manipulation on memory for threat related words in anxious individuals. Specifically, it has important implications for interventions clinicians make when working with individuals experiencing anxiety. Helping clients think about the distance of events in time can have beneficial outcomes. For example, individuals with anxiety tend to relate to negative memories, which lead them to anticipate negative future events which they perceive as more vivid and very likely to happen (Trope & Liberman, 2010). Therefore, helping anxious individuals to understand that negative future events are not as likely to happen as they might imagine, can help in the process of working towards more positive achievable goals for their future.

Why an experiment?

This study was based on a recent manuscript in preparation which showed that backward vection (i.e., the process of inducing perception or sensation of movement) improved recall of neutral words (Aksentijevic, 2017). Bearing in mind the critical voice and relational stance that resonates with me as part of my training as a counselling psychologist has inevitably led me to question my methodology. An experiment is in line with quantitative tradition and perhaps does not go hand by hand with qualitative research. However, an experiment was the best way to match my motivation with quantitative literature.

Introduction

High-trait anxious individuals demonstrate a variety of information processing biases. They are more likely to attend to threat-related compared to neutral stimuli than individuals with low anxiety. In regard to this, threat-relevant material refers to stimuli that can elicit anxiety and attract attention to a threat before evaluation occurs (Bar-Haim, Lamy, Pergamin, Bakermans-Krsnenburg, & Van-IJzendoorn, 2007). In such situations, persons are also more likely to interpret ambiguous information as threatening and selectively recall threatening stimuli (Mughal, Walsh, & Wilding, 1996; Mitte, 2008). This means that anxiety is linked with a variety of cognitive biases influencing attention, interpretation, memory and reasoning (Zoe & Field, 2013; Harvey, Watkins, Mansell, & Shafran, 2004). Cognitive models of susceptibility to anxiety suggest that these cognitive biases play a part in the aetiology and maintenance of anxiety disorders (Beck & Clark, 1997; Eysenck, 1992; Williams, Watts, MacLeod, & Mathews, 1997). Specifically, it is proposed that unhelpful beliefs, memory bias and distorted perception are crucial to the understanding and treatment of anxiety disorders (Beck, 1967; Ellis, 1958).

Anxiety refers to feelings of excessive fear, worry and related behavioural disturbances (Norton & Sears-Edwards, 2017). Anxiety can be adaptive and helpful but when it is excessive it can lead to adverse effects on daily functioning (Strack, Lopes, Esteves, & Fernandez-Berrocal, 2017). Specifically, individuals with anxiety disorders report feelings of tension and physical symptoms such as sweating and increased heart rate (Schmidt, Norr, Allan, Raines, & Capron, 2017) as well as experiencing recurring intrusive worrying thoughts. They may avoid situations because of excessive worry or engage in coping behaviours that are counterproductive (Naragon-Gainey, McMahon, & Chacko, 2017). It is suggested that avoidance is less adaptive than seeking directly to deal with threat, since avoidance involves cognitive distancing and ignoring or minimizing the stressor, thus inhibiting the possibility of processing and resolving the stressor (Riley, Wright, Bokszczanin, & Essau, 2017). Theory suggests that anxious mood will influence the type of events individuals can access and recall (Bower, 1987).

Despite theory proposing that anxious individuals show enhanced memory towards threat-related material, research findings remain inconsistent (Mitte, 2008). Some studies show higher recall of threat-related versus neutral words in high-trait anxious compared to low individuals, while others demonstrate lesser recall of threat related words. A review on memory bias in anxiety disorders indicates that there is inconsistency in research findings in relation to the role of avoidance in anxiety and memory. Furthermore, there is a large amount of experimental psychological research evidence, which shows that anxious individuals selectively attend to threat: that is, they show an attentional bias

towards threatening material in the environment over neutral material (Coles & Heimberg, 2002; Bar-Haim et al., 2007). More specifically, attentional bias refers to the tendency to selectively attend to specific stimuli (Morales, Brown, Taber-Thomas, LoBue, Buss, & Pérez-Edgar, 2017). Whereas, other experimental research has shown that clinically anxious individuals avoid threat-related material and attend more to neutral stimuli compared to non-anxious controls (Coles & Heimberg, 2002; Koster, Crombez, Verschuere, Van-Damme, & Wiersema, 2006). In relation to this, it has been suggested that anxiety leads to initial hypervigilance towards threat, which is then followed by avoidance in processing the threatening stimulus because it is difficult to stay with the anxiety (Koster et al., 2006; Onnis, Dadds, & Bryant, 2011). This can lead to a lack of deep processing of threat-relevant information, resulting in poorer memory for that information (Koster et al., 2006). Clinicians can use this knowledge when treating patients who experience anxiety, as the tendency to avoid processing threat-related information plays a key role in the maintenance of the anxiety disorder, thus serving to maintain emotional problems (Onnis, Dadds, & Bryant, 2011).

Experimental studies examine explicit and implicit memory bias (i.e., conscious and unconscious retrieval of information, respectively) using explicit and/or implicit memory measures (Coles & Heimberg, 2002; Mitte, 2008). This means that explicit memory bias is revealed by conscious and overt measures whereas implicit memory bias can be exposed by covert measures such as fMRI. In relation to this, one study investigated memory bias with both explicit and implicit memory measures. Thirty-four participants were presented with neutral pseudo-words (e.g. ‘’muxo’’), which were paired with aversive or neutral pictures. Memory was assessed by recall and fMRI scans immediately after learning and at a 4-day follow up. Results have shown that higher trait anxiety was correlated with stronger amygdala activation for negative stimuli significantly more than for neutral stimuli (Eden et al., 2015). Research has shown that memory has a central role in the regulation of negative emotion (Tran, Joormann, & Hertel, 2011). Specifically, studies suggest that individuals actively retrieve good memories as a way of regulating negative mood (Josephson, Singer, & Salovey, 1996). Therefore, memory bias operating during the processing of, for example, a dangerous situation can influence the ability to regulate emotions which can then lead to susceptibility to anxiety disorders (Joormann, Yoon, & Siemer, 2009). This means that memory bias can be seen to play a significant role in the onset, maintenance and recurrence of anxiety disorders (Tran et al., 2011).

The investigation of memory bias in anxiety disorders is essential from both clinical and research perspectives for the development of treatment. Specifically, establishing a better understanding of cognitive processes that operate in anxiety-related disorders is important for the

purposes of alleviating suffering in clinically anxious individuals and enabling them to improve their sense of well-being. Furthermore, greater understanding of how to better process threat-related stimuli and by that ensure better control of cognitive biases is in line with the notion of mindfulness which refers to being aware of what is happening in the present (Walsh, Balint, Smolira, Fredericksen, & Madsen, 2008). Mindfulness has been shown in research to have positive outcomes with anxiety in that it moves the individual away from rumination, thus enabling them to be more receptive and aware of the present (Walsh et al., 2008). This means that better understanding of how to access threat-related stimuli rather than avoiding them, can lead to a clearer sense of immersion in the present and may facilitate the achievement of better therapeutic outcomes when working with anxiety disorders.

Although evidence is strong for attentional bias in anxiety (Bar-Haim et al., 2007), there is mixed evidence for memory bias in both implicit and explicit memory bias in anxiety. Indeed, intuitively one would expect that the preferential attention towards threat or hypervigilance that characterises anxiety (Eysenck, 1992) would lead to better memory performance. However, avoidance, a central component in anxiety, may lead anxious individuals to avoid deep processing of threat-relevant information which can decrease memory for threat by reducing the amount of encoding or limiting retrieval of threat-relevant information (White, Ratcliff, & Vasey, 2015).

In relation to this it was suggested in an influential model that individuals might show decreased processing of threat-relevant material due to avoidance playing a central role in their anxiety (Williams, Watts, MacLeod, & Mathews, 1988; 1997). This suggests that anxious individuals avoid deep processing of threat-related material, leading to impaired memory for threat-related information. However, a review on memory bias in anxiety indicated that individuals with anxiety exhibited higher memory for threat-related information on free recall tasks (Coles & Heimberg, 2002). Therefore, pervasive affect-congruent biases do not appear to extend throughout the entire cognitive system. Furthermore, in a recent study it was similarly suggested that anxious individuals are initially hypervigilant towards threat-related material but then proceed to adopt avoidance of any deep processing because of the discomfort it may cause (Booth, 2017).

It is important to distinguish between two stages operating in memory: the encoding stage and the retrieval stage. The encoding stage refers to the process whereby information is placed in memory whereas the retrieval stage refers to the process of recollecting previously encoded information (Brown & Craik, 2000). In one meta-analytic review of memory bias for threat-relevant material in anxiety disorders, one hundred and sixty-five studies with clinical and non-clinical samples were investigated (Mitte, 2008). Results showed evidence of memory bias in anxious individuals for the recall of threat-

related information (i.e., anxious individuals remembered more threat-relevant words). However, implicit memory bias for anxious individuals was not found. The extent of the memory bias depends on experimental procedures such as encoding procedure and retention interval. Furthermore, the clinical status of participants was not significantly related to effect size. This means that there was no significant difference between participants with anxiety disorders and participants with trait anxiety. A limitation of this review lies in the possibility that the findings on implicit memory may be confounded with explicit memory processes. For instance, word completion was used to test implicit memory bias, despite the inability of the researchers to rule out whether participants used explicit memory strategies to perform the task. In relation to this, the current study had used explicit measures of free recall (i.e., recall in any order). Mitte's (2008) meta-analysis suggests a significant relationship between anxiety and recall, in turn suggesting that more research is required to further understand memory in anxiety. In the light of the above-cited literature it can be argued that biases in processing threatening stimuli have a significant role in the etiology and maintenance of anxiety disorders (Bar-Haim et al., 2007). Attentional bias towards threat-related stimuli refers to differential attentional allocation towards threatening stimuli compared to neutral stimuli (Cisler & Koster, 2010). This means that if threat related information and neutral stimuli appear simultaneously, the attention of an anxious person will be biased towards the threat-related information (Cisler & Koster, 2010). The attentional system of anxious individuals may be uniquely sensitive to and biased in favor of threatening information in their environment. Bar Haim et al. (2007) conducted a meta-analytic review, which investigated attentional biases for threat-related stimuli in anxiety. The results showed that the bias is evident (with low to medium effect size; d=0.45) when using various experimental paradigms and under a variety of experimental conditions both explicitly (i.e., consciously recalled) and implicitly (i.e., outside of conscious awareness) in anxious individuals (i.e., clinically disordered or individuals high on trait anxiety) and is not seen in non-anxious individuals. Consequently, attentional bias in anxiety has robust support in research. The finding of similar effect size bias across all the anxiety disorders may indicate that there is a core anxiety component shared by them all.

Furthermore, there is ample research showing links between memory retrieval and the reproduction of the original encoding context (Dewhurst, Conway, & Brandt, 2009; Morris, Bransford, & Franks, 1977; Tulving & Thompson, 1973). Specifically, context reinstatement refers to enhanced recall of specific information when the context present at the time of encoding the memory and at the time of retrieving the memory is the same (Manning, Polyn, Baltuch, Litt, & Kahana, 2011). Furthermore, episodic memory refers to a unique recollection of an experience which contains information such as

what happened, where and when it took place (Ameen-Ali, Norman, Eacott, & Easton, 2017). It can be different from another person's memory of the same experience, which means that it is a subjective experience of recollection (Tulving & Markowitsch, 1998).

In relation to this, one recent research study research has shown that context reinstatement is important for memory retrieval success (Aksentijevic, 2017). Specifically, It has been shown that backwards movement brought participants psychologically closer to the past and specifically to the time of encoding which is likely to have reinstated contextual cues, thereby enhancing episodic recollection and thus recall (Aksentijevic, 2017). This means that inducing a sense of movement backwards in time called 'past directed time travel' helps reinstate the encoding context thus facilitating recall (Aksentijevic, 2017). It is surprising, therefore, that no published study to date has attempted to reinstate the encoding context of threat-related material in anxious individuals by inducing participants to mentally travel back to the moment of encoding. Therefore, the rationale for the present study is the possibility that some of this recall-relevant contextual information could be recaptured by mentally transporting the participant back to the moment at which they experienced it.

Furthermore, it has been shown recently that one way to reinstate context is to induce mental time travel. This refers to the sense of movement in time that can be induced by physical and imaginary motion (Botzung, Denkova, & Manning, 2008). Aksentijevic (2017) has shown that induced mental time travel (i.e., watching videos of a train moving) can enhance recall when using backward motion. This means that using backward vection may induce mental travel which (involuntarily) takes the individual back to the moment when they encoded the information. This might help anxious individuals retrieve threat-related words and relive the anxiety they felt when they were reading threat words, therefore accessing their mood when encoding the memory. However, it is not possible to predict whether the memory bias would be away from or towards the threat-relevant words. The impact of vection may be related to the notion that memory may be better understood generally in relation to movement (Aksentijevic, 2017). Time and space are often perceived both in science and everyday life as two distinct entities. However, it is suggested that a better understanding of reality requires that both entities be integrated into one superordinate whole (Aksentijevic & Treider, 2016). Bringing memory and space together can be done in various ways. The most widely used method is discretisation, which means that experience is broken into discrete spatial representations, which are then analysed; for example, breaking a film into individual scenes. Discretization of time is widely used in science and is the only method of coping with the relation between space and time. Whilst discretization enables a better insight into complex processes, it has limitations, for example it cannot explain motion by means of static

models (Aksentijevic & Treider, 2016). This explains why vection can provide a good framework for understanding the abstract sense of the passing of time.

An abstract concept of time is better understood when used in relation to space (Boroditsky & Ramscar, 2002). This means that experiencing and thinking about spatial movement has been shown to influence the way individuals understand time (Aksentijevic, 2017). Thus, when participants imagine moving, they imagine time as moving with them. However, when individuals imagine an object moving towards them, they perceive themselves being closer to a future event. This is because the future is perceived psychologically as if it is approaching the present, whereas the past recedes from the present (Caruso, Boven, Chin, & Ward, 2013). This means that individuals present as having a feeling that they are moving with regard to a 'static' time whilst others experience time as 'rushing' towards them (Aksentijevic, 2017).

Furthermore, thinking about the future influences posture (i.e., when thinking about the future, there is a tendency to lean forward and when thinking about the past there is a tendency to lean backwards (Miles, Nind, & McRae, 2010). Furthermore, it has been shown that individuals are able to move relative to time and scientists can observe these effects by using vection (Caruso, Boven, Chin, & Ward, 2013). These authors conducted a series of four studies in which they showed that when participants were asked to estimate the distance from the present to a real or abstract point in the future or past, they underestimated future distance. This may be understood as a similar phenomenon to the Doppler effect where there is a change in the perceived pitch of a sound as the source of the sound approaches the observer (Doppler, 1842). The third study by Caruso et al. (2013) utilized a sense of motion by means of virtual reality (using a head-mounted display). Participants who experienced forward vection underestimated future distance in comparison to participants who experienced backward vection who tended to overestimate future distance. Thus, backward movement had reduced the common tendency for the future to be closer than the past. This means that vection seems mentally to relocate participants into the past or the future. This can have potentially important implications for therapeutic interventions for anxiety disorders, for example, by helping patients who tend to catastrophize future events to see such events as less close to them than is usually perceived by high or clinically anxious individuals.

Vection is also able to influence the locus of thought (Miles, Karpinska, Lumsden, & McRae, 2010). The authors showed that participants who were exposed to backward vection, by means of an animated star moving either towards or away from the centre of a display on a computer, had thoughts about the past. Given that backward vection mentally brings individuals closer to the past in terms of

their perception of time, leads to the question of whether backward vection can enhance memory by taking individuals back to the point in the past when they encoded information.

Furthermore, a recent study has shown that contextual cues are imperative for recollection of threat-related material when using vection-based intervention (Aksentijevic, 2017). It is indeed a well-known principle that contextual cues facilitate better recollection (Ameen-Ali, Norman, Eacott, & Easton, 2017). However, the above study has examined this with vection-based intervention for the first time. Specifically, this was an experimental study whereby participants were asked to try and remember a list of 20 words. They were then given a vection-based intervention, meaning that they watched a train moving backwards or forward, or a video of random motion. Finally, they were asked to recall the words they had learned. Results showed that individuals recalled more words when they had experienced backward motion compared to forward or random motion. This means that going back in time by means of inducing a sense of backward motion brought participants back to the time of encoding the list of words, so that they recalled more words when experiencing backward vection compared to forward or no vection at all. This suggests that contextual cues can be efficiently evoked by means of vection based intervention.

Thus it appears that bringing back the participant to the stage of encoding (i.e., registering the information into memory) should allow them to better recall information at the retrieval stage (i.e., ability to access information from the memory) as the context of encoding is the same at both stages. In other words, it shows that reinstating encoding conditions at retrieval stage enhances episodic recollection. The current study bases its rationale on the importance of context for successful recall, and on the significance of mood-congruent memory. This refers to the higher recall of stimuli that carry an emotional tone equivalent to the current mood of the individual (Blaney, 1986). For example, depressed individuals recalled sadder memories compared to non-depressed participants (Clark & Teasdale, 1982). It would appear that when individuals learn written information it can have an impact on their emotions. Specifically, when threat-related words are processed, the individuals concerned may experience some sense of anxiety. Following this, when using vection-based intervention, participants can be brought back to the specific context of the encoding situation, so that high-trait anxious participants might be able to access the anxious mood resulting from learning threat-related words.

The present study examined whether a vection-based intervention can enhance the retrieval of threat-related words over and above that for neutral words, thereby counteracting the lack of deep encoding of threat-related words in anxious individuals. Consequently, the current study's original contribution to knowledge is the *first attempt* to explore whether the use of a vection-based intervention

(i.e., an induced sense of movement) leads to an improved access to threat-related material in anxious individuals. Specifically, the current study aims to explore whether vection-based intervention can expose memory bias in individuals with high anxiety trait. This is clinically important as initial vigilance to threat-relevant information followed by avoidance might prevent the objective evaluation of threatening material, leading to continuing anxiety in already anxious individuals (Coles & Heimberg, 2002). Thus, the achievement of better understanding of how vection-based intervention can influence the retrieval of threat-relevant information may lead to important progress towards better treatment for anxiety disorders.

Reflection

Anxiety is a common experience across species (Coles & Heimberg, 2002). However, some clients present with difficulties managing it whilst others appear better able to do so. As a counselling psychologist in training, it seems that I am learning to manage my own anxiety in relation to day-to-day anxiety that comes from working with individuals who experience emotional difficulties and traumatic experiences. This led me to think that understanding more about anxiety would be beneficial for clients as well as clinicians. A recent study has shown that backward vection (i.e., the process of inducing perception or sensation of movement) *improves recall of neutral words (Aksentijevic & Treider, 2016). Also, reinstating at retrieval stage the context that existed at encoding stage is known to enable better recall ability (Rinaldi, Locati, Parolin, & Girelli, 2017). This has led to the interesting notion of testing whether motion manipulation may affect how anxious (i.e., high-trait anxiety) participants perceive threat words. Specifically, linking the sense of movement to memory recall is interesting for me as it provides a new perspective on the research of memory bias, thus addressing a research gap since memory in anxious individuals has never been tested under the influence of vection based intervention.*

Furthermore, as a counselling psychologist in training I need to negotiate between my roles as a practitioner and a scientist. Reflecting on my development as a practitioner, the use of diagnoses has led me to question whether 'one size fits all'. I do not think that one size can capture the variability in experiences and characteristics of individuals that I encounter when working with clients. It is rather limiting and restricting to think that there is only one way of conceptualising a client's problems. I rather prefer to position myself in a floating position where I hold in mind various methods of conducting research and of theoretical frameworks, hopefully being able to navigate from one to the other according to the client's needs and wishes. In other words, working collaboratively with the client, while at the same time being able to work with what is helpful to them individually. However, I am aware that at times it is easy to fall into a rather restrictive way of seeing things, as that can be both more containing while helping with my own anxiety as a practitioner. This could particularly occur whilst having to navigate through times where both myself and the client stumble in our attempts to understand their subjective experience. The current climate requires us to measure and provide quantitative data as a way of assessing if a client is on their way to recovery. Having a pluralistic point of view therefore recognises the diversity around us (Kasket & Gil-Rodriguez, 2011).

A key part of my identity as a counselling psychologist in training is engaging with empirical research as well as engaging with psychotherapeutic relationships. In other words, it is important to contribute not only in the consulting room but also to research and society. I can see myself drawn to quantitative methods as it enables me to use quantifiable measures, which helps me in understanding a topic of research. However, I am also drawn to the qualitative way of researching where one can get a deeper understanding of how individuals think and feel. For me, either way of conducting research can be limiting as it shines light on only one angle of the phenomenon. Therefore, both quantitative and qualitative ways of researching are essential so we can understand a phenomenon from various angles.

I am aware that any research, including this study, sheds light from only one specific perspective and therefore is limited in terms of generalising it to everyone. Yet this approach enables a micro-investigation of important phenomena. The specific research question that is posed by the current study is: 'Does the use of a vection-based intervention lead to improved access to threat-related memories specifically in anxious individuals?' Answering this requires the employment of quantitative methods, as I would need to compare the means of words that are recalled by anxious participants compared to controls. Using a mixed methods design could indeed answer the research question and go hand in hand with my pragmatism stance. However, due to the limited scope of time, it was not feasible and not necessary in order to answer the research question. Furthermore, a qualitative approach could have been utilised as well by interviewing participants and asking them on the lived experience of dealing with anxiety as well as whether they felt immersed in the videos of movement. However, due to the limited scope of time this was not practicable and not necessary in order to answer the research question.

Therefore, my research philosophy lies with those pragmatists who believe that reality is constantly changing in terms of how one interprets it and in relation to the time in history in which it takes place; for example, homosexuality was once seen as a mental illness until it was removed from the Diagnostic and Statistical Manual of Mental Disorders (DSM) in 1973, whereas nowadays it is much more acceptable and not seen as a disorder. Therefore, the stance that I choose to adopt when doing research is the pluralistic stance, which posits that there is no single right way, and this approach is an important part of counselling psychology (Scotland, 2012). This means that I try to be flexible in my epistemological stance and in my espousal of a particular theory of knowledge - in other words, the way I endeavor to view reality. I am aware that no matter what method one uses to answer the research question, it is limited in that it sheds light on only one specific aspect of the phenomenon.

It is important to acknowledge that research takes place within a relationship (Kasket, & Gil-

Rodriguez, 2011). I aim to provide all participants with a safe and welcoming atmosphere, which mirrors the 'vibe' that I aim to provide to my clients in the consulting room. This comes from the understanding that the research I engage with arises from my practice (i.e., noticing that most patients battle in one way or another with anxiety), and that the findings from my research would feed back into my practice and enrich it. Therefore, it could be argued that using experimental research would perhaps reduce the problems of research subjectivity. However, it is probably impossible to completely remove a researcher's subjectivity in the exploratory process of finding out more about the links between memory bias and mental time travel. Being aware of it and aiming to provide the same environment and attitude to all participants should help to address this whilst being open to the examination of blind spots.

To summarise: I am aware that this is a very new area of research and there is a need for further research to be carried out to understand the relationship between memory bias in anxiety and mental time travel. However, this study provides a fruitful start to this journey. The research journey in this topic is very much in parallel to my own journey as a practitioner where time in history and new knowledge generated would continue to evolve and lead me to question and reflect critically on myself as both a researcher and practitioner.

Generalised Anxiety Disorder (GAD)

The present study made use of a sub-clinical group of participants with high trait anxiety. Literature on people with GAD is relevant since high trait anxious individuals have a greater tendency to develop GAD than other individuals (Penney, Mazmanian, & Rudanycz, 2013). GAD refers to excessive and insistent general worry with frequent changes of focus (Aikins & Craske, 2011). It was suggested that GAD would be more precisely named as Generalised Worry Disorder in the DSM-5 (Andrews & Hobbs, 2010). GAD is the most frequent presentation in primary care and has the highest lifetime prevalence of all anxiety disorders (Somers et al., 2006). It is often co-morbid with physical pain and discomfort such as irritable bowel syndrome, sleep difficulty or general sense of annoyance and thus it is often presented to practitioners as a somatic symptom (Lowe, Spitzer, Williams, Mussell, Schellberg, & Kroenke, 2008). GAD has a lifetime prevalence rate of 4-7% (Newman el al., 2013). It is a disorder of prolonged, overpowering worry characterized by physiological symptoms: for example: disturbed sleep, muscle tension, and difficulty concentrating. The disorder is associated with a lower rate of full time work, social difficulties and increased risk of suicide (Borkovec, Alcaine, & Behar, 2004).

Furthermore, it was suggested that GAD should be classified together with Major Depressive Disorder since symptoms such as exhaustion and sleeping problems appear common to both disorders (Grant et al., 2005; Hendriks et al., 2014). In relation to this the Cognitive Content Specificity model argues that these disorders are distinct since individuals with Major Depressive Disorder focus on the past and often negatively evaluate themselves, the future and the world around them, whereas individuals with GAD focus on thoughts about the future and fears about their ability to cope (Beck, Epstein, Brown, & Steer, 1988). The Contrast Avoidance Model of GAD is an important model of worry in GAD (Newman & Llera, 2011). This model is based on affective contrasts whereby the perception of a stimulus can be influenced by its preceding state. Specifically, if a negative stimulus has been perceived as threatening it will be experienced as even more threatening by a high-trait anxious individual if it is followed by a positive stimulus, and less threatening if it is preceded by a more threatening stimulus (Llera & Newman, 2014). For instance, an increase in fear caused by a threatening stimulus will be experienced more intensely if preceded by a positive or neutral state, while decreased if it is preceded by a similar threatening state.

Llera and Newman (2014) conducted a study to test the tenets of the Contrast Avoidance Model of GAD. Participants with GAD and a control group of non-anxious participants were randomly allocated to engaging-in-worrying, relaxing, or neutral tasks. Specifically, in the worry task, they were told to

imagine that which they are most fearful of and then worry about it as intensely as possible. The relaxation task involved breathing slowly, while the neutral task was to read neutral information. They were then shown fearful, sad or comical videos. Their skin conductance response and self-reported emotional experiences were recorded. The results supported the tenets of the Contrast Avoidance model. Specifically, people given the worry task were already in a more negative mood than those in the other tasks, which led them to avoid the shift in negative emotion in response to a negative video compared to the others. Furthermore, all participants experienced an increase in positive emotion following the comical video. This may indicate that anxious participants had a stronger positive emotional contrast than participants in other conditions. It suggests that the positive emotion may be serving as reinforcement in the form of a sense of relief that events turned out to be more positive than had been expected.

This appears to show that people with GAD are more influenced by negative emotional contrasts than non-anxious people and the avoidance of this contrast encourages their worry. Relating to this, participants with GAD seemed to prefer to avoid negative emotional contrast whilst the non-anxious preferred the opposite. It seems likely that anxious people take a negative stance so they can better cope with their emotional state relating to threatening situations which, it can be argued, may suggest that they use worry as a means of preparing themselves for anticipated negative events.

In relation to this the tripartite model suggests that negative emotion is associated with both GAD and Major Depressive Disorder but that each disorder consists of a specific unique component (Clark & Watson, 1991): Major Depressive Disorder being associated with a feeling of being low in mood, and anxiety associated with high arousal (Anderson & Debra, 2008). Research suggests that both models together best distinguish between Major Depressive Disorder and GAD (Beck, Benedict, & Winkler, 2003). The lifetime prevalence of GAD is about 5.7% (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2005) with individuals experiencing symptoms of GAD between five and ten years before they receive a diagnosis (Keller, 2002). This indicates that GAD is unlikely to remit without therapy. In terms of gender differences, it appears that the course of GAD seems to be the same in both females and males (Campbell et al., 2003) but females are more likely to meet a higher number of DSM criteria, whereas males are less likely to seek help than females (Kessler et al., 2005). The impact of GAD is argued to be significantly damaging for the individual and have implications for society as a whole (Allgulander, 2006). In one study participants with GAD and non-anxious controls completed self-report questionnaires to do with quality of life, worry and depression symptoms. Results have shown that participants with low levels of quality of life were correlated with having GAD. Furthermore,

individuals with GAD reported themselves as having lower quality of life than controls (Henning, Turk, Mennin, Fresco, & Heimberg, 2007). This shows the significant negative impact which individuals with GAD experience in relation to their daily functioning and their relationships.

In one study of quality of life, productivity and costs were examined in individuals with GAD compared to non-anxious controls, using cost analysis formulas as well as self-reported questionnaires such as health related quality of life (HRQoL). It was found that frequency and amount of reduced efficiency in the work-place and numbers of sick days taken by individuals with GAD are higher compared to the non-anxious and present a significant financial burden to the UK (Toghanian, DiBonaventura, Jarbrink, & Locklear, 2014). Additionally, individuals with GAD utilise A&E and hospital services more than non-anxious individuals. Furthermore, those with moderate and severe levels of GAD used more health care resources than individuals with mild GAD. This shows the significant financial impact that GAD has on the economy (Toghanian et al., 2014).

The psychological approach to GAD recommended by the National Institute for Health and Care Excellence (NICE, 2011) consists of drug treatment through selective serotonin reuptake inhibitor (SSRI) and/or therapy which is usually Cognitive Behaviour therapy (CBT) either in self-help, group settings or in individual therapy. There is significant inconsistency in research findings examining the efficacy of CBT for GAD (Hoffman, Asnaani, Vonk, Sawyer, & Fang, 2012). In some studies CBT for GAD is linked with significant clinical change but there appear to be no definite long term positive benefits (Siev & Chambless, 2007). In one meta-analysis the efficacy of Cognitive Therapy (CT) for worry symptoms in GAD was examined. Results have shown that CT had better outcome than no intervention at all (Hanrahan, Field, Jones, & Davey, 2013). However, CT efficacy for worry symptoms in GAD was lower than that achieved through other therapies (Hanrahan et al., 2013). This indicates that CT is effective compared to no intervention at all. A model for GAD proposed by Wells (2005) argues that therapy for GAD needs to put emphasis on maintaining the anxiety rather than trying to reduce symptoms, if there are to be long lasting effects. CBT concentrates on questioning the content of the worry in GAD but in most cases one worry might well be replaced by another (Wells, 2007). Thus, better understanding of the cognitive mechanisms operating in GAD is needed. Furthermore, in a Cochrane review on therapy for GAD for adults, twenty-five studies were included comparing CBT to a control group, a waiting list group or a no intervention given group, and studies comparing CBT to another therapy (Hunot, Churchill, Teixeira, & Silva de Lima, 2007). Results have shown that CBT was better in reducing symptoms of anxiety compared to the waiting list or no intervention groups. However, evaluation of long-term effects was beyond the scope of the review. When CBT outcomes were

compared with other therapies such as psychodynamic therapy results were less conclusive. This current review is limited by the lack of definitive research comparing the effectiveness of CBT for GAD with that of other therapies.

In an additional meta-analysis examining psychological treatment of GAD results have shown that CBT was more effective in reducing symptoms of worry, anxiety and depression compared to waiting list (Cuijpers et al., 2014). CBT also had better outcomes at a 12 month follow up compared to relaxation techniques only. This shows that CBT can be argued to be effective in relation to GAD symptoms, but it is not conclusive whether CBT is superior to other therapies in the treatment of GAD (Hunot, Churchill, Teixeira, & Silva de Lima, 2007). It would appear that research findings to date are not conclusive in regard to the treatment of GAD. In relation to this, it is suggested that early reinforcement of avoiding anxiety provoking situations might play a key role in the maintenance of anxiety in GAD (Dadds, Barrett, Rapee, & Ryan, 1996) as well as anxious reactions being learned behaviour. It is argued that individuals with high trait anxiety might have been exposed to sudden and uncontrollable adverse situations (Mineka & Zinbarg, 2006). Furthermore, individuals with GAD have lower tolerance for the fact that the future is unknown (Dugas, Buhr, & Ladoucuer, 2004).

The Intolerance of Uncertainty model for GAD includes intolerance of uncertainty, poor problem-solving skills, worry and cognitive avoidance (Dugas, Gagnon, Ladouceur, & Freeston, 1998). Intolerance of uncertainty refers to a tendency which influences how uncertain scenarios are perceived and interpreted (Dugas et al., 2004). The difficulty with what the future holds occurs when thinking 'what if?'. Also, individuals with GAD report perceiving worry as a positive element as it helps them to prepare for new and challenging situations. It is also argued that individuals with GAD have a lessened ability to problem solve compared with individuals without GAD; and they do not believe in themselves in terms of their ability to problem solve. Furthermore, it is argued that individuals with GAD cognitively avoid any stimuli that contain worry (Dugas, Marchand, & Ladouceur, 2005).

Intolerance of Uncertainty refers to negative emotional, cognitive and behavioural reaction to uncertainty (Borkovec, 2002). It is associated with severe level of GAD in comparison to other clinical disorders (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Gentes & Ruscio, 2011). In the limited research evidence for the efficacy of treatments that target Intolerance of Uncertainty, CBT has been found to significantly reduce intolerance of uncertainty (Van-der Heiden, Muris, & van der Molen, 2011). The Intolerance of Uncertainty model was examined in a study conducted by Ladouceur, Gosselin and Dugas (2000). Participants were allocated to either high or low intolerance groups. They were presented with a gambling computer game whereby the high intolerance group was told that there

is a low chance of winning whereas the low intolerance group was told there is higher chance of winning. Results have shown that participants experienced higher level of worry in the high intolerance compared to the low intolerance group. This suggests that Intolerance of Uncertainty is a key element in worry in GAD. Another influential model in GAD is the metacognitive model proposed by Wells (2005). This model suggests that individuals with GAD utilise worry as a strategy for coping with the stressful event but when worry becomes obstinate and fixed, negative metacognitive beliefs are activated and the outcome is 'worrying about worrying'. This leads to increased anxiety, thought suppression and a need for support in an effort to reduce the anxiety. This then leads to the perception that worry is dangerous, thus maintaining the vicious worry cycle (Wells, 2005). This means that GAD is maintained by experiencing contradicting positive and negative beliefs in relation to worry, with an emphasis on the role of metacognitions as central element in this process. It is suggested in this model that individuals with GAD interpret the bodily symptoms of anxiety and metacognitions as verification for the damaging influence of worrying and therefore they do not think that it is safe to stop worrying (Wells, 2005).

One study examined the effects of metacognitive therapy for individuals with GAD (Wells & King, 2006). Participants' anxiety, depression and worry were measured before and after therapy. Participants who received CBT in the past were not included in the study. Results have shown that participants' symptoms of anxiety, depression and worry were clinically improved after receiving metacognitive therapy both at the end of therapy and at follow-ups. However, a limitation for this study comes from the use of only a small sample and it is not clear whether the improvement was solely because of metacognitive therapy as half of the participants had additional diagnoses. In relation to this, another study explored metacognitive therapy by comparing it with intolerance of uncertainty therapy and delayed treatment in individuals with GAD (Van der Heiden et al., 2012). Both metacognitive and Intolerance of uncertainty therapy are designed as fourteen structured sessions. Presentation of GAD was evaluated before therapy, immediately after therapy and at six months after therapy. Results have shown that both metacognitive therapy and intolerance of uncertainty therapy reduced symptoms of GAD. Furthermore, metacognitive therapy and intolerance of uncertainty therapy had better outcomes in relation to reducing GAD symptoms than delayed therapy. Additionally, participants who experienced metacognitive therapy had alleviated their worry in comparison to the level of worry they experienced prior to therapy, as indicated by the Penn State Worry questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990). This indicates that both metacognitive therapy and intolerance of uncertainty therapy were effective in reducing GAD symptoms.

An additional important model in GAD is Emotion Dysregulation (Mennin, Heimberg, Turk, & Fresco, 2002; Mennin, Turk, Heimberg, & Carmin, 2004), which suggests that individuals with GAD experience emotions more intensely than non-anxious individuals. It also hypothesizes that those individuals with GAD have a lower understanding of their emotions and have more negative evaluations and fear of emotions. Furthermore, individuals with GAD have maladaptive ways of regulating their emotions, which leads them to experience more distress than they experienced initially (Mennin, Heimberg, Turk, & Fresco, 2005). Therefore, individuals with GAD might feel overwhelmed because of the intensity of the emotions they feel which serve to reinforce their fear. It is also postulated that individuals with GAD would be either hyper vigilant to threatening stimuli and allocate attention to it, or avoid it and without paying any attention to it (Mennin et al., 2005). In other words, individuals with GAD would either attempt to control their emotions in order to minimise any exposure to uncomfortable emotions or worry excessively in an attempt to regulate their emotions. A limitation to this model is that there is no developmental account as to how an individual with GAD might develop a pattern of experiencing emotions more strongly than non-anxious individuals.

Research suggests that difficulty in managing emotions plays a central role in GAD as well as the aversive response to emotions (Mennin et al., 2004). In one study, participants completed daily diaries in which they recorded their thoughts and feelings as well as completing a questionnaire measuring emotion regulation techniques (called Emotion Regulation Strategies Questionnaire, ERSQ; Feldman-Barrett, Gross, Christensen, & Benvenuto, 2001). Results have shown that participants with GAD reported more difficulties dealing with emotions compared to controls who were not clinically anxious (Decker, Turk, Hess, & Murray, 2007). However, individuals with GAD did not show less ability to use emotion regulation techniques compared to controls (Decker et al., 2007). This study finding is in contrast to other research surveys that suggest that individuals with GAD have maladaptive management of emotions techniques (Marganska, Gallagher, & Miranda, 2013; McLaughlin, Gomez, Baran, & Conrad, 2007; Mennin, Heimberg, Turk, & Fresco, 2005).

Worry as a key element in the experience of anxiety

The present study examines memory bias in anxiety in which worry plays a key role and it is argued to be a maladaptive cognitive coping mechanism (Moreno, Avila-Souza, Gomes, & Gauer, 2015). Thus, this section is devoted to 'worry'. Worry refers to a psychological process in which people experience negative thoughts in relation to future events (Moreno, Avila-Souza, Gomes, & Gauer, 2015). It is further suggested to be a maladaptive cognitive coping strategy which individuals utilise in an attempt to prevent or solve future problems (Borkovec, Ray, & Stober, 1998). More specifically, this strategy enables the individual to avoid concentrating on the problem, since they are busy worrying in relation to the future (Midboe, 2010; Beck, Gayle, Stanley, & Zebb, 1995; Barlow, 2004). Paradoxically, worry increases negative affect (Stout, Johnson, Shackman, & Larson, 2015). This can be adaptive as it leads the individual to rehearse courses of action in relation to the threatening anticipated events. Worry is a fairly common phenomenon, which is related to sense of fear and when experienced to excess, might prove harmful (Silverman, LaGreca, & Wasserstein, 1995). It is suggested that worry is a key aspect of anxiety disorders as it enhances distress and disturbs daily functioning such as sleep and social interactions (Newman, Llera, Erickson, Przeworski, & Castonguy, 2013; Stout et al., 2015).

Furthermore, anxious individuals consider worry as a strategy for coping with negative affect (Newman et al., 2013). Research suggests that worry is a key component of GAD (Kertz, Bigda-Peyton, Rosmarin, & Björgvinsson, 2012). Worry is a key part of the diagnostic criteria for GAD (DSM-5, American Psychiatric Association, 2013). It has been repeatedly found in research that individuals with GAD perceive their worry as more pervasive and out of their control than individuals who experience worry without GAD (Beck, Gayle, Stanley, & Zebb, 1995). Thus, worry generates such a negative affect that the person who is high-trait anxious is likely to experience less emotional contrast when facing negative information, so that that their subjective perception would be along the lines of 'if I am feeling bad anyway then I can't possibly feel worse if something bad actually happens'. This suggests that anxious people may prefer to maintain worry despite its negative affect, as it is perceived as a defense against future threatening situations. Additionally, this can serve as a reinforcement for worry in people with GAD as they might feel a great sense of relief if expected negative situations do not happen and something positive happens instead (Llera & Newman, 2014).

Closely related to this is the experience of severe anxiety, which is an exaggerated response to danger without any apparent external threat (Lang & Craske, 1997). Anxiety, like fear, is a shared experience between individuals and exists in every stage in life. Mild or occasionally moderate levels of

anxiety are normal and can be adaptive (Marks, 1987). However, for some individuals, anxiety can become debilitating. Unlike mild anxiety of short duration, severe anxiety can be chronic and lead to significant difficulties. When the anxiety experienced is disproportionate to the actual threat, is of significant intensity, frequency, and duration, and hinders various aspects of life such as relationships or work performance, then it is considered to be a disorder (Norton, & Sears-Edwards, 2017).

In relation to this, Lang (1977) suggests that anxiety influences three main aspects: behavioural, physiological and cognitive responses. Behavioural responses include avoidance of fearful information, scenarios, or environments, which are perceived as threatening. Most individuals with high levels of anxiety report the experience of physiological responses such as muscle tension, headaches, nausea, palpitations and hyperventilation (Barrios & Hartmann, 1997). The cognitive component of anxiety is considered to play a central role in the development and/or maintenance of anxiety. Common cognitive features of anxiety include excessive worry, overly self-critical thoughts, attentional biases, interpretive biases, while there is mixed evidence regarding memory bias in relation to both towards and away from threat (Mitte, 2008).

Research suggests that worry may be a cognitive strategy used as a way of overcoming difficulties with emotional regulation. In relation to this, the Cognitive Avoidance theory of worry (Borkovec et al., 2004) suggests a way to understand the relationship between worry and emotional difficulties. This theory proposes that identifying threat creates a problem, which leads the organism to find a way to avoid or decrease the risk for survival purposes. If it is impossible to move away or escape from the threat-related situation, as, for example, where the threat is internal and not present in the external environment, engaging in a cognitive activity is the only way that is left to deal with it. Therefore, worry is a cognitive attempt to solve the problem of a future danger since by being so busy worrying one avoids dealing with the danger or the threat in the present.

Anxiety disorders are extremely widespread, incapacitating, and linked to considerable morbidity and mortality, making them an increasing concern for clinicians as well as public policymakers (Stout, Shackman, Johnson, & Larson, 2015; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). The key characteristic of extreme anxiety (phobic anxiety) is exaggerated worry where there is the absence of real danger (Grupe & Nitschke, 2013). Pathological levels of worry, which are a significant component of most anxiety disorders, are experienced in the form of repetitive and intrusive thoughts relating to threatening future events which impose a great strain on the limited-capacity working memory system (Leigh & Hirsch, 2011). Constantly elevated anxiety partially indicates the anxious person's overreliance on maladaptive cognitive coping strategies, including worry (Barlow,

2004). Therefore, worry serves as a rather unhelpful approach when attempting to avoid or escape distress, in that it functions to enhance negative affect (Newman, Llera, Erickson, Przeworski, & Castonguay, 2013).

Prevalence Rates of anxiety

This sub section will explore prevalence rates of anxiety in order to understand how common is the experience of anxiety. The prevalence of anxiety disorders is challenging to determine, because even minor changes in the diagnostic criteria, interview techniques, or methodology utilized in studies may influence the results (Lepine, 2002). A combination of anxiety and depression is the most common mental health disorder in the UK with 7.8% of the population experiencing symptoms that warrant diagnosis (NICE, 2011). The most recent Psychiatric Morbidity Survey suggests that there are about three million individuals with an anxiety disorder (McManus, Meltzer, Brugha, Bebbington, & Jenkins, 2009). Anxiety disorders inflict high individual and social costs, tend to be long lasting and can be debilitating. Specifically, the economic costs of anxiety disorders include emergency care; reduced productivity; absence from work; and suicide (Lepine, 2002).

Worry seems to occur in the absence of any clear and looming threat. Usually worry represents "What if . . ." mental representations of past and possible future events that are common in daily life (Borkovec, 1985). These features imply that worry may reflect difficulties in deleting threat-related information from working memory (Stout, Shackman, Johnson, & Larson, 2015). Working memory can be defined as the system responsible for the transient storage and manipulation of information. It is involved in information processing that is required for completing everyday tasks (Derakshan & Eysenck, 2009). Working memory comprises short-term memory and processing of the temporarily stored information. Short-term memory deals with immediate processing as well as supporting recall of information (Baddeley, 2012). When threat-related information enters working memory, it may continue to bias attention and memory retrieval even though it is no longer part of the external environment, and this serves to promote worry.

One novel study examined whether individual differences in worry reflect difficulties deleting threat-related information from working memory (Stout, Shackman, Johnson, & Larson, 2015). Specifically, they examined whether people with higher levels of worry - measured using the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) and the State–Trait Anxiety Inventory; Spielberger, 1985) - are less efficient at deleting threat-related information from working memory. Participants were presented with threat-related faces and neutral faces. They were then asked to remember one or more threat-related face. They found that participants with higher levels of worry compared to participants with low levels of worry remembered more threat-related faces than neutral stimuli. Furthermore, worry was associated with difficulty in filtering out threat-related faces but not

neutral faces from working memory. This suggests that if irrelevant threatening information needlessly enters working memory, an individual with high levels of worry will find it difficult to block this compared to neutral information. This further shows that prioritizing threat-related information enables worry to remain in working memory long after the threat has been removed from the external environment (Newman, Llera, Erickson, Przeworski, & Castonguay, 2013). Therefore, the key problem is in blocking out or deleting threat-related material from working memory.

Fear

In summary, worry refers to thoughts and images that are associated with negative affect and somewhat uncontrollable (Midboe, 2010). Worry is argued to be a strategy to problem-solve an issue whose outcome is unknown, as there may be a number of negative possible outcomes. Thus, worry is closely linked to fear (Torrents-Rodas, Fullana, Bonillo, Caseras, Andion, & Torrubia, 2013; Midboe, 2010; Beck, Gayle, Stanley, & Zebb, 1995). Fear refers to an evolutionary reaction to perceived or real threat in the environment (Panksepp, 1998). Fear creates behavioural and psychological reactions so that the individual can evaluate the threat in order to survive and avoid any damage (LeDoux, 1998). Threatening stimuli would often lead to defensive reactions such as freezing or avoidance, which will also involve physiological arousal (Lang & Bradley, 2010). Fear relates to arousal to forthcoming threat whereas anxiety is suggested to be arousal to awaited and predicted future threat (Tovote, Fadok, & Luthi, 2015). Both fear and anxiety are seen as adaptive but excessive fear and anxiety can lead to the development of anxiety disorder (Kessler et al., 2005). Research has found that individuals with a high-trait anxious individuals have been found to have a higher risk of developing anxiety disorders (Beesdo, Knappe, & Pine, 2009). Furthermore, high trait anxiety is linked to increased arousal to learned threat (Browning, Behrens, Jocham, O'Reilly, & Bishop, 2015).

The literature on fear distinguishes between fear conditioning and fear extinction. Fear conditioning refers to the process whereby one associates neutral stimuli with negative outcome. Recurring demonstrations of the neutral cue alongside the aversive result, such as loud noise, will lead to a conditioned response of fear to a neutral stimulus (Phelps, Delgado, Nearing, & LeDoux, 2004). Relating to this, fear extinction refers to a repeated exposure to the neutral stimulus without the negative outcome (for example, without the loud noise), which will lead to extinguishing the association between the neutral stimulus, and the adverse outcome (Phelps et al., 2004). In relation to anxiety disorders research suggests that the fear extinction process is disturbed in individuals with anxiety who might show suspended fear extinction or where fear extinction might not be evident at all (Milad & Quirk, 2012). Nevertheless, in one recent meta-analysis, little difference was found in fear extinction between individuals with anxiety disorder and non-anxious individuals (Duits et al., 2015).

Intolerance of uncertainty refers to the tendency which influences how uncertain scenarios are perceived and interpreted (Dugas, Buhr & Ladouceur, 2004). High-trait anxious individuals as well as individuals with anxiety disorders might find it challenging to accept that they may experience future negative situations which might lead them to classify neutral stimuli as possibly threatening (Carleton,

Fetzner, Hackl & McEvoy, 2013). Research suggests that intolerance to uncertainty is found in individuals with GAD as well as across the anxiety disorders (Carleton et al., 2013; McEvoy & Mahoney, 2012). Research additionally suggests that individuals with high trait anxiety or, in other words, individuals who are prone to developing anxiety disorder, might generalise threat to both threat-related and neutral stimuli (Dymond, Dunsmoor, Vervliet, Roche, & Hermans, 2015).

Working memory

Working memory refers to capacity-limited storage where information is temporarily kept whilst plans are being shaped or implemented (Just & Carpenter 1992); it is linked with representations in long-term memory (Cowan, 1999). In relation to this, Baddeley and Hitch (1974) developed a multicomponent model of working memory. A three-level system is proposed which consist of two secondary systems within a verbal and visuospatial element named the 'phonological loop' and 'visuospatial sketchpad' respectively. These enable temporary storage and processing of information and they are managed by a 'central executive' sub system (Miyake et al., 2000). It was suggested by Eysenck (1998) that the working memory acts as a mediator between anxiety and cognition, which has led to the development of several theories. The Processing Efficiency Theory differentiated between accuracy of task performance and amount of resources invested (Eysenck & Calvo, 1992). In relation to this, it is proposed that anxiety-related thoughts which are not relevant to the task in hand weaken processing efficiency, while worry will cause the individual to be more alert which will counterbalance the effect of anxiety. Nevertheless, the processing efficiency theory does not stipulate which executive functions are damaged or account for situations whereby anxious individuals are better at a cognitive task than non-anxious individuals (Eysenck & Derakshan, 2011).

Following the processing efficiency theory, attentional control theory was proposed (Derakshan & Eysenck, 2009; Eysenck & Derakshan, 2011). This suggests that anxiety weakens processing efficiency and the central executive, irrespective of the task in hand. Furthermore, the inhibition mechanism of the central executive is weakened because of ineffective efforts to fight task-irrelevant interference. The shifting element of the central executive is also damaged by anxiety as high-anxious individuals are argued to struggle to shift their attention from threatening stimuli to the task in hand. Lastly, attentional control theory suggests that investing more effort in the task as a way of compensating becomes more difficult when the task in hand is challenging and thus will lead to reduction in performance compared to non-anxious subjects (Eysenck & Derakshan, 2011). However, research findings which support attentional control theory remain inconclusive, with some studies which provide support and other which contradict its assumptions (Lavric, Rippon, & Gray, 2003).

Literature Review

The processing of threat-related stimuli by individuals with anxiety has been associated with a distinctive pattern of cognitive biases (Williams, Watts, MacLeod, & Mathews, 1997). Theory suggests (Mathews & MacLeod, 2005; Eysenck, 2004) that individuals with anxiety will demonstrate an enhanced memory for threat-related material (i.e., memory bias), selectively attending to threat-related information (attentional bias) and are thus likely to endorse a threatening interpretation of ambiguous stimuli (i.e., interpretative bias). This cognitive pattern is assumed to lead to exaggerated negative perceptions and evaluations, which serves as a key element in the maintenance of anxiety, establishing a vicious cycle of cause and effect (Mathews, 1990). Research findings to date have supported this argument, showing that attentional biases towards threat-related stimuli are associated with clinical and subclinical anxiety using a range of stimuli including words, faces and pictures (Yiend et al., 2015).

The present study sets out to test a sub-clinical anxiety group, divided into low and high trait anxious subgroups using STAI. It has been shown that individuals with GAD seem to allocate attention towards threat-related stimuli and this is more pronounced in individuals showing high anxiety as against those individuals with low anxiety (Georgiou, Bleakley, Hayward, Russo, Dutton, Eltiti, & Fox, 2005). In relation to this, cognitive theories of emotional disorders, including (GAD) suggest that cognitive biases (including memory bias) are key factors in the etiology and maintenance of the psychopathology (Mathews & MacLeod, 2005). Biases play an important role in increasing the risk of the onset, maintenance and, if untreated, the recurrence of a disorder (Yiend et al., 2015). There is a substantial amount of research that shows the existence of an attentional bias in anxiety (Mitte, 2008). It has been proposed that anxious individuals tend selectively to attend to threatening stimuli (Eysenck, 2004). Therefore, anxious individuals and those with anxiety disorders selectively attend to negative information (Bar Haim et al., 2007). Specifically, threat-related stimuli capture the attention of anxious individuals. Furthermore, one study has shown that the memory advantage for threat-related information in anxious individuals is not a consequence of response bias (Russo, Whittuck, Roberson, Dutton, Georgiou, & Fox, 2007). Since a stimulus that is closely attended to would also mean that it is remembered better, one can also expect a memory bias in anxious individuals. However, findings are not conclusive, with some research supporting memory bias in anxious individuals with other research contradicting it (Mitte, 2008).

A review of memory biases across the anxiety disorders

The Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 1994) uses categorically defined symptoms and examines their impact on functionality to warrant clinical diagnoses. The diagnoses are: Generalized Anxiety Disorder (GAD), Social Phobia (SP), Specific Phobia, Panic Disorder with or without Agoraphobia, Obsessive-Compulsive Disorder (OCD), and Posttraumatic Stress Disorder (PTSD). Individuals with PTSD usually report experiencing unwelcome memories in the form of flashbacks of the traumatic event they had experienced. Furthermore, individuals with SP can often recount the vivid details of experiencing strong embarrassment in public. Individuals with panic disorder (PD) often experience frightening thoughts of having a heart attack, which can be perceived as detrimental. This is normally reinforced by recollections of their worst panic attack. These examples propose that anxiety disorders are characterized by the heightened accessibility of threat-related information. If so, they should be associated with a memory bias, or preferential memory, for threatening information.

The inconclusive research findings regarding memory bias in anxiety sits in contradiction to information models that suggest that there is heightened sensitivity to remembering more threat-relevant information in the high-trait anxious compared to the low anxious. Furthermore, it suggests that, despite shared features arising in anxiety disorders, the high-trait anxious and low anxious also differ in many aspects such as focus of anxiety and age of onset (Coles & Heimbers, 2002). These differences of focus may have a role in the mixed findings found in research as well as in studies using different methods to test memory bias in anxiety. It is further suggested that the presence of explicit memory biases towards threat-relevant information differs according to the type of anxiety disorder.

A large body of evidence indicates that explicit memory bias operates in Panic Disorder (Coles & Heimbers, 2002). Additionally, there are studies that show support for explicit memory bias in Post-traumatic stress disorder (PTSD) and Obsessive-compulsive disorder (OCD). However, these are few in number. There is no support for explicit memory biases in General anxiety disorder (GAD) and Social phobia (SP). Nevertheless, there is some evidence for implicit (unintentional retrieval of threat-relevant information) memory bias across the anxiety disorders (Coles & Heimbers, 2002). It is therefore suggested that when testing anxiety disorders as a whole, there is little evidence for explicit memory biases for threatening stimuli and modest support for implicit memory biases (Coles & Heimberg, 2002). Nevertheless, investigation of research findings by specific diagnoses shows that various anxiety disorders display various degrees of memory bias. Specifically, individuals with PD most commonly

show explicit memory biases for threatening information - mainly information that has been deeply encoded. Nevertheless, there is very little support for implicit memory biases in PD. Additionally, there is little support for both explicit and implicit memory bias for threat-related stimuli in PTSD and OCD. Finally, individuals with SP or GAD do not seem to show general explicit memory biases but might be influenced by implicit memory biases.

Interpretive bias

A large body of research suggests that individuals who are high-trait anxious tend to interpret ambiguous scenarios in a threatening way (Tran, Joormann, & Hertel, 2011; MacLeod & Bradley, 1998), which leads them to experience anxious reactions to everyday challenges (Macleod, Rutherford, & Mathews, 2006). Researchers examined the influence of cognitive interpretive bias on memory (Tran et al., 2011). Participants were taught to interpret text, describing ambiguous situations in either a positive or negative way. They were then given new descriptions of situations to interpret. Results show that the training indeed induced interpretive bias in participants. Importantly, these findings show that participants who were trained to have a positive interpretation were more likely to recall never presented positive information whilst the individuals who were trained to interpret information negatively were more likely to recall never presented negative details. This suggests that interpretive bias may affect recollection of information.

Bower (1981) – this model forms the basis for the present study

Bower (1981) suggests that the current mood of an individual affects his or her ability to encode and retrieve information. This model argues that memories are stored in different locations according to mood and that in order to retrieve a memory one has to access the same mood experienced when encoding the memory. In relation to anxiety, according to Bower (1981), anxious individuals need to be anxious both at encoding and at retrieval if they are to recall more threat-related words. Bower posits that the bias towards threat-related information operates when a node (i.e. a representation of an emotion) is activated. The node is related to other nodes such as memories. The stimulation of the node leads to an increased availability of information congruent with that node.

Specifically, this theory proposes that events are denoted in memory as groups of associative pathways between various concepts or nodes reflecting the way the individual constructs the event. Different emotions have different nodes in memory. Therefore, the individual's mood at the time of encoding memory biases the creation of the memory associative pathways, which leads to a preference

for encoding mood-congruent material. Therefore, it is suggested that if mood at recall is the same as it was at encoding, recall of mood-congruent material should be greater. A limitation to this theory comes from assuming selective encoding and retrieval of threat-related stimuli in anxious individuals but not discriminating between (a) implicit memory - that is, a memory that is unintentionally recalled and, (b) explicit memory, that is, a memory that is consciously recalled and easily verbalised (Schacter, 1987).

Beck (1976) Theory that suggests an account for the processing of threat-related stimuli

Beck (1976) proposed the schema theory, which posits that cognitive processing is guided by schemas, which significantly influence how information is attended to, interpreted and remembered. A schema refers to a pattern of thinking that helps organise and interpret information. In relation to anxiety, this theory suggests that anxious individuals are biased toward threat-relevant material since their anxiety primes them to attend more to threat-related material compared to neutral information. Consequently, anxious individuals favour threat-relevant information at all stages of processing including attention, stimulus, memory and interpretation. Distortion of the schema leads to distortion in information processing (Beck et al., 1985, 1979). In anxiety, the schema is typically characterized by danger (Kendall & Watson, 1989). Encoding and recall of threat-relevant information is argued to happen when the schema is activated. This means that, according to this theory, both encoding and recall of threat-relevant information would be facilitated when the relevant schema is activated.

Refinements on the Beck (1976) model: Eysenck, Derakshan, Santos and Calvo (2007)

Eysenck et al. (2007) suggest that individuals with anxiety increase the allocation of attention for threatening information, which leads to the argument that anxiety reduces the attention that is allocated to a current task if it does not involve threat-related stimuli. Specifically, this suggests that when individuals consider themselves to be experiencing threat and thus anxiety, they allocate attention widely and not specifically to the task in hand. This means that they will have reduced attentional control with regard to an ongoing task (Fox, Russo, & Georgiou, 2005). Attentional control theory suggests that anxiety influences two central functions: inhibition and shifting. Inhibition refers to the ability to regulate an automatic response. Shifting refers to the shift of attention between tasks. Eysenck et al. (2007) suggest that anxiety impairs inhibition, meaning that it reduces the extent to which inhibitory mechanisms can regulate automatic responses. This can be demonstrated in the difficulty in disengaging attention from distracting threat-related stimuli.

Beck, Emery and Greenberg (1985)

The model by Beck, Emery and Greenberg (1985) characterises emotional difficulties through a schema. This means that the processing of a stimulus by an individual is facilitated in a way that is congruent with the content of an existing schema. More specifically, when a dysfunctional schema relating to threat-related information is activated, this leads to the selective processing of information congruent with that schema. In anxiety, the content of the schema will be related to danger and difficulty in managing threatening situations. Thus, it can be argued that anxious individuals would remember threat-related stimuli better than controls since this is determined by their schema (Mitte, 2008). However, there is a discrepancy between the arguments made by the above model and research findings which show that that anxious individuals do not always demonstrate memory bias for threat-related material (Coles & Heimberg, 2002).

Williams, Watts, Macleod and Mathews (1988, 1997)

Williams, Watts, Macleod and Mathews (1988) distinguished between integration and elaboration, which are both part of the processing of stimuli. It is proposed that integration strengthens the structure of the internal representation of a stimulus. For example, even a small part of the stimulus will lead to the activation of the whole structure so that the stimulus will enter one's mind. In contrast, elaboration concentrates on the connection between the presented stimulus and other mental representations. Since it is more likely that an individual will retrieve a stimulus that has strengthened old paths, elaboration is related to explicit memory.

Williams et al. (1988) suggested that integration and elaboration are two independent processes whereby if a bias occurs in one it will not be associated with a bias in the other. Furthermore, they proposed that anxiety relates more to integration than elaboration, which means that anxiety relates more to implicit memory than explicit memory. This model argues that a new stimulus is classified as low or high threatening by an individual and this depends on the significance of the stimulus itself and the state of anxiety of the individual. If the stimulus is classified as threatening, individuals with trait anxiety will selectively prefer the processing of this stimulus. By contrast, where elaboration occurs, it is either the case that no extra resources are allocated for the processing of a stimulus characterised as threatening (which means that anxiety would not lead to increased recall of threat-related stimuli) or there is a removal of resources which can lead to worse recall of threatening stimuli in anxiety. Williams et al. (1988) suggested that high-anxious individuals would have implicit memory bias rather than

explicit memory bias. This model leads to the expectation that anxious individuals would show an implicit but not explicit memory bias for threat-related material.

Williams et al. (1988) set out to update this model since research evidence has not shown implicit memory bias in all studies. However, there is some evidence for explicit memory bias in anxiety. The authors differentiated between memorial and non-memorial elaboration. They argued that anxiety is related to non-memorial elaboration (i.e., a threatening stimulus evokes feelings of worry in anxious individuals but it is not better remembered by these individuals). Furthermore, a stimulus that activates memorial activation (i.e., is better remembered by individuals) is not influenced by the person's level of anxiety. Therefore, no relationship between anxiety levels and recall should be found.

Williams et al. (1988, 1997) proposed a model that seems to account for the conflicting views of some authors, suggesting that anxious individuals are hypervigilant toward threat-relevant stimuli where others propose that anxious individuals avoid threat-relevant stimuli. This model posits that anxious individuals tend to direct their attention toward threat-relevant stimuli during early, automatic processing stages. However, at later and more strategic stages of processing, anxious individuals tend to direct their attention away from threat. The attention toward threat-relevant information would heighten the anxiety of the individual. However, this would be followed by avoidance of threat-relevant stimuli, which would prevent a more elaborated evaluation process that could potentially reduce the perceived danger in the threat and lead to reduced anxiety (Bar-Haim et al., 2007). This means that avoiding the threat-relevant stimuli serves a role in maintaining the anxiety as it prevents a deep evaluation process that would lead to the understanding that the stimulus is not as dangerous as initially perceived (Coles & Heimberg, 2002).

Furthermore, avoidance can decrease prolonged processing of threat-relevant material which can lead to decreased memory for threat by reducing the amount of rehearsal in encoding (Koster et al., 2006). In contrast, White, Ratcliff and Vasey (2015) propose that, since anxious individuals present with hypervigilance toward threat-relevant material, their memory for threat should be enhanced as well. This is because information that is selectively attended to should be better encoded and hence may lead to stronger memories. This may lead to anxious individuals remembering their environment as much more threatening than it actually was in reality. Williams et al. (1988, 1997) proposed two cognitive mechanisms that are responsible for threat-related bias in anxious individuals. These are: an affective decision mechanism (ADM) and a resource allocation mechanism (RAM). The purpose of the ADM is to assess how threatening the stimulus is. The RAM receives input from the ADM and decides on resource allocation. Consequently, this leads to high trait anxious individuals showing a tendency to orient their

attention towards threat whereas low trait anxious individuals shift attention away from threat. Furthermore, the direction of attentional resources towards threat increases as anxiety increases (interaction hypothesis). Notably, anxiety treatment should focus mainly on the RAM since this is the mechanism influencing the bias towards threatening stimuli. Treatment may alleviate anxiety by redirecting attentional resources away from the source of threat, a strategy adopted by low trait-anxiety participants (Mogg & Bradley, 1998).

Williams et al. (1997) introduced key changes to the model whilst keeping central components such as the interaction hypothesis. These changes were introduced to accommodate the lack of consistency in research findings regarding explicit and implicit memory biases in anxiety. The distinction between implicit and explicit memory was changed to a dichotomy of perceptual (i.e. bottom-up) and conceptual (i.e. top-down) processing. Confusingly, perceptual and conceptual tests may either be explicit or implicit in nature. Indeed, previous cognition and emotion studies did not distinguish between perceptual and conceptual processing, by employing explicit conceptual and implicit perceptual tests (Williams et al., 1997). This means that there is a need for congruency in the type of processing exhibited in the study and test phases for an observed benefit in memory tests to be evident. Indeed, failures in controlling the type of cognitive processing used by participants at study and test phases of an experiment (Nugent & Mineka, 1994; Roediger & McDermott, 1992) may have been responsible for these ambiguous findings.

Mogg and Bradley (1998)

Mogg and Bradley's (1998) theory emphasises attentional bias in anxiety, but it can also be used to explain memory bias. They proposed that two systems are operating: one that decides how threatening the stimulus is and the second that decides on allocating processing resources. If a stimulus is characterised as threatening, individuals will allocate their resources to the threat-related stimulus. This model proposes that anxiety is related to the evaluation of the environment as dangerous, rather than to the allocation of resources. This means that both high and low anxious individuals would allocate a similar amount of resources once a stimulus is classified as dangerous. This further suggests that high-trait anxious individuals evaluate more stimuli as dangerous than low anxious individuals but when processing threat-related stimuli, both allocate the same amount of resources. A stimulus would be classified as dangerous or not in relation to evolutionary adaptation.

This model can be applied to memory bias. Memory for threat can be seen as adaptive as it enables the learning of sources of threat, resulting in better avoidance of danger and consequently

leadings to a greater chance of survival. In a study by Thompson and Pandeirada (2007), a memory for survival-related material was found to a greater degree in recall than in recognition. Therefore, it can be argued that when a stimulus is evaluated as threatening, it is better remembered as it is adaptive and consequently that it is better encoded in memory. It would follow that, according to this model, differences in selective memory exist between high and low anxious individuals but these differences will disappear once the stimulus is classified as high threatening.

In summary, individuals with anxiety demonstrate a variety of information processing biases. They are more likely to attend to threat-related than to neutral stimuli; they are more likely to interpret ambiguous information as threatening and selectively recall threatening stimuli (Mughal, Walsh, & Wilding, 1996). A recent study does not point to different patterns in recall between anxious and non-anxious individuals (Sanz-Blasco, Miguel-Tobal, & Casado-Morales, 2014). The authors examined whether memory is hindered in individuals with high levels of evaluation anxiety compared to low levels of evaluation anxiety. Participants were allocated to high and low anxiety groups. They were presented with evaluation anxiety content words versus neutral words and asked to recall the words. The results showed that there was no difference between recall of evaluation anxiety content words and neutral words in individuals with evaluation anxiety. This study, therefore, fails to demonstrate that anxious individuals show a different pattern in the recall of threat-relevant information compared with non-anxious individuals.

One recent study tested memory bias with both implicit and explicit measures (Eden et al., 2015). The authors state that memory bias (i.e., the tendency to recall more threat-relevant words in anxious versus non-anxious individuals) is under debate with mixed research findings. Therefore, the researchers investigated memory bias with both explicit and implicit memory measures. Thirty-four participants were presented with neutral pseudo-words, which were paired with aversive or neutral pictures. Memory was assessed by recall and fMRI scans immediately after learning and at four-day follow up. The results show that higher trait anxiety is correlated with stronger amygdala activation for negative stimuli than for neutral stimuli. This study, therefore, appears to indicate that implicit memory bias exists in anxious individuals.

Moderating factors

This sub-section explores the factors that may be involved in the relationship between anxiety and working memory and might, therefore, provide some explanation of the inconsistency in research findings in relation to memory bias in anxiety. In one study authors examined the relationship between self-control of anxiety and performance in a cognitive task (Bertrams, Englert, Dickhäuser, & Baumeister, 2013). Self-control refers to the process of intentionally overriding one's responses (Inzlicht & Schmeichel, 2012). The authors hypothesised that one needs to have a sense of self control in order to revert attention from anxiety-related thoughts or worries, as that would distract the individual and thus impair performance (Bertrams et al., 2013).

In this study, participants' self-control resources were depleted and their performance was compared with that of others whose self-control resources were not depleted. This was done by measuring state anxiety using State Trait Anxiety Inventory (STAI; Spielberger, 1985) and exploring its influence on verbal learning and arithmetic performance. Self-control resources were manipulated using a writing task from Schmeichel (2007), in which participants were asked to write a description of an event occurring when they were of school age, while those in the depletion condition were instructed to delete letters e and n from their passage. Those in the non-depletion condition were asked to write the description of the event without anything else. Results have shown that state anxiety was correlated with test performance for individuals who had their self-control resources depleted both on verbal learning and arithmetic task. This suggests that ability to control one's attention by moving it away from anxiety-provoking stimuli may improve performance in cognitive tasks. In another study participants performed less well on verbal tasks when trying to suppress their anxiety-related thoughts or worries in comparison to neutral thoughts (Hallion, Ruscio, & Jha, 2014). This suggests that worry did not impair cognitive performance in a verbal task.

It was suggested that evaluation anxiety involving negative thoughts which are not relevant to the task in hand, as well as task-related worries such as 'I am not doing well' has an effect on cognitive performance. This was examined in a study which assessed anxiety using a heart rate measure and state anxiety using a revised test anxiety scale (Coy, O'Brien, Tabaczynski, Northern, & Charles, 2011). Negative irrelevant task thoughts were measured using a cognitive interference questionnaire (Sarason & Stoops, 1978). Participants received anxiety-inducing instruction while other participants received supportive instructions. Results show that individuals who received anxiety-provoking instructions experienced higher frequency of negative irrelevant thoughts which led to poorer performance on the

cognitive task compared to participants who received supportive instructions (Coy et al., 2011). This suggests that anxiety and irrelevant anxiety-provoking thoughts or worries impair performance on cognitive tasks. This supports the processing efficiency theory of Eysenck and Calvo (1992), which argues that negative thoughts, which are not relevant to the task in hand, adversely influence working memory and thus performance on cognitive tasks.

Another factor, which was suggested as likely to impair cognitive performance, is worry. It is argued that individuals who worry a lot have less working memory capacity when they experience worry whilst trying to complete a cognitive task than individuals who worry less (Hayes, Hirsh, & Mathews, 2008). Literature also suggests that individuals worry in verbal form (Stokes & Hirsch, 2010). One study examined whether verbal worry reduces more working memory capacity than worry induced by images, in individuals with high levels of worry compared to individuals with low levels of worry (Leigh & Hirsch, 2011). Participants engaged with verbal or imagery-based worry tasks, and the performance on these tasks of low and high worriers was compared. Selection into the high worrier group versus the low worrier group was based on scores achieved using the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990). Results show that those who were higher on worry had less working memory capacity in relation to verbal worry compared to imagery, as well as being more anxious than those who were less of a worrier (Leigh & Hirsch, 2011).

Additionally, the threat of risk of shock has been shown to increase anxiety and thus impair working memory on verbal tasks (Lavric, Rippon, & Gray, 2003). Furthermore, it has been suggested that performance on verbal tasks, which require working memory, is influenced by the task difficulty or cognitive load (Shackman et al., 2006). In relation to this, one study examined the relationship between cognitive load and performance on cognitive tasks (Vytal, Cornwell, Letkiewicz Arkin, & Grillon, 2013). Participants' performance on spatial and verbal tasks of increasing difficulty was compared between those who were at threat for risk of shock and those who were not threatened. Results have shown that those with risk of shock had poorer performance on both verbal and spatial working memory, which refers to memory that is responsible for registering information about the environment and spatial orientation (Courtney, Petit, Maisog, Ungerleider, & Haxby, 1998).

Another factor, which, it is suggested, may play a role in performance on cognitive tasks, is *mental effort* (Williams, Vickers & Rodrigues, 2002). In one study participants evaluated the meaning of emotional stimuli which require attention and working memory resources, whilst worrying that they might experience impending pain; as against another group of participants who were not anticipating impending pain (Kalisch, Wiech, Critchley, & Dolan, 2006). The cognitive tasks participants were

required to perform varied activities, ranging from the less difficult - meaning a low cognitive load - to more challenging tasks, entailing a high cognitive load. Results show that participants reported higher effort under high cognitive load and high anxiety conditions compared to participants who experienced lower cognitive load and low anxiety conditions (Kalisch et al., 2006). Other studies suggest that anxiety may lead to increased effort, which can result in better performance on cognitive tasks (Visu-Petra, Miclea, & Visu-Petra, 2013). The failure to measure directly mental effort, puts into question any interpretations on the relationship between mental effort and performance on cognitive tasks. The findings from studies that used induced anxiety and examined its effect on verbal working memory (Coy et al., 2011; Hallion et al., 2014; Visu-Petra, Miclea, & Visu-Petra, 2013) suggest that spatial working memory was largely intact. This is in line with Attentional Control Theory (Eysenck et al., 2007), which suggests that anxiety leads to higher attentional resources invested in threatening stimuli (Eysenck, et al., 2007).

Furthermore, research findings which suggest that mental effort (Kalisch, Wiech, Critchley, & Dolan, 2006; Williams, Vickers, & Rodrigues, 2002) may possibly alleviate any adverse effects of anxiety are also in line with Attentional Control Theory. However, Attentional Cognitive Theory is not able to provide an explanation for the full pattern of findings. Specifically, anxiety seems only to disrupt verbal working memory under conditions of low to moderate cognitive load and not high cognitive load (Vytal et al., 2013). Nevertheless, spatial working memory was impaired both when cognitive load was high and when it was low to moderate (Vytal et al., 2013). This means that anxiety seems to activate an automatic reaction to promote survival via the identification of danger, and this results in restricted resources becoming available for spatial working memory. The above studies were well designed to examine the relationship between anxiety and memory. Specifically, The threat of shock as a way of inducing anxiety seems very effective, as well as being verified through psychological measures of anxiety such as the STAI (Spielberger, 1985).

Vection as a way to induce Mental time travel

Atance and O'Neill (2001) introduced the concept of future thinking. They built on Tulving's (1985) definition of episodic and semantic memories. Semantic memory is a general knowledge of the world. Lieberman and Trope (2000) posit that individuals view distant future events more abstractly than immediate future events. Furthermore, when planning for the future, individuals tend to consider obstacles only when it is an immediate future event. This means that individuals may adopt a semantic way of thinking about the future rather than an episodic viewpoint, and this may decrease the accuracy of their predictions. This would suggest that linking episodic future thinking (i.e. pre-experiencing an event) to memory biases in anxiety can help inform better treatment for anxiety disorders.

Miles, Karpinska, Lumsden and Macrae (2010) posit that the human ability to pre-experience the future based on prior experience is evident across cultures. This is important to the current study as perception of the future is linked to movement through space (vection). These researchers investigated whether movement through space influences vection. Participants performed a dull task, which was expected to create daydreams whilst watching animations with backward vection or forward vection. Subjects were asked to report their unrelated thoughts whilst watching the animations. It was found that moving back in time encouraged thinking about the past and moving forward in time encouraged thinking about the future. These findings further strengthen existing evidence that mental time travel is associated with movement in space. A limitation to this study comes from questioning whether the effects of vection would transfer to physical movement. It is possible that if participants were required physically to move, the effects would be amplified.

Caruso, Boven, Chin and Ward (2013) suggest that the reason individuals view the past as more distant than the future, despite equivalent objective distance, is parallel to spatial perception. This means that the distance between the self and the future decreases, whereas the distance between the self and the past increases; just as objects seem spatially distant the further they are positioned from the self. This suggests that perceived movement across space is linked to perceived movement across time. These researchers conducted an experiment where they manipulated time by going backward in time through virtual space. Results show that when going back in time, the perception that future events are closer than past events, despite equivalent time distance, was eradicated. This is very important in anxiety disorders where individuals view future events negatively which may maintain their anxiety.

MacLeod and McLaughlin (1995) tested both implicit and explicit memory in individuals with GAD and a group of non-anxious controls. Participants were presented with threat-related words and

non-threat-related words. The authors used a mixture of tests: in the explicit test, participants were presented with words that they had seen before in an initial task which asked participants to name the colour of the word and also to say it. The explicit memory task required participants to circle the words that they had recognised from before. Lastly, the implicit memory task was to identify words from the initial task, but on this occasion some words that had not been presented initially, but were matched in length, were used. It was found that individuals with GAD showed implicit memory bias for threat-related words whereas there was no difference between clinical participants and controls with regards to explicit memory bias for threat-related words. This study shows an implicit and not an explicit memory bias for threat-related words, as measured by the recognition task in individuals with GAD. In contrast, a subsequent study did show both implicit and explicit memory bias in individuals with GAD in comparison to non-anxious controls (MacLeod & McLaughlin, 1995). The current study tested for explicit memory bias in individuals with high trait anxiety compared to low trait anxiety as measured by free recall.

Research suggests that individuals with high trait anxiety perceive that they are more at risk than other individuals for experiencing threat-related events (Gasper & Clore, 1998). It was suggested that this reflects the frequency of threat-related information occurring in their memory (Hasher & Zacks, 1984). One study aimed to test how people who differ in trait anxiety monitor threat-related and neutral words (Gasper & Clore, 1998). Participants were asked to recall the words they had seen and report the number of times they think they had seen each word. The authors used a median split to divide participants into high and low anxiety groups following completion of the trait component of the Spielberger State-Trait Anxiety Inventory (STAI) (Spielberger, 1985). Individuals with high trait anxiety reported a higher number of estimated occurrences of threat-related words than participants with low anxiety. Both groups reported similar frequencies of neutral words. Furthermore, both groups recalled more threat-related words than neutral words (Kverno, 2000). This reflects the non-conclusive findings that research presents in regards to recall of threat-related words in anxious and non-anxious individuals. More research is needed to understand further the mechanisms that operate in memory for threat-related words in anxious and non-anxious individuals. Specifically, understanding the relationship between vection based intervention and memory in anxiety is needed.

In relation to anxiety as a key aspect of the current study, it is important to think about worry. Since the key feature of anxiety is worrying about future threat as well as rumination, which is typically directed at past negative events and losses (Fox, Dutton, Yates, Georgiou, & Mouchlianitis, 2015), thus making temporal psychological distance (i.e. the perception of the distance in time from present to a point in the future and in the past) an important factor in anxiety. A good understanding of the links

between the way people in their present relate to their future and past selves is important for psychotherapy practice (Crossley, 2000). Anxiety is associated with events in time (Eysenck, Payne, & Santos, 2006). Specifically, the clinical hypothesis is that anxiety is associated with future threat-related events whilst depression is associated with past loss (Wenze, Kathleen, Gunthert, Ramaris, & German, 2012). Furthermore, a very recent study attempted to explore whether people with anxiety traits would demonstrate a more pronounced tendency to perceive the future as closer than the past in comparison to controls and whether people with depressive traits would perceive the past as closer than the future compared to controls. Students were recruited and divided into an anxiety traits group; a depressive traits group and a control group who did not meet the clinical threshold for anxiety or depressive traits. They were asked to rate one month ahead and one month ago from, 1) being 'really close to present' to 10), being 'really far from present'. The authors used the Minnesota Multiphasic Personality Inventory (MMPI-2-RF), which is a psychological scale that assesses psychopathology including anxiety and depression traits. The results showed that the predisposition to perceive future events as closer than past events was much more pronounced in participants with anxiety traits compared to controls.

In contrast, participants with depressive traits demonstrated a much-reduced tendency to perceive the future as closer than the past compared to controls (Rinaldi, Locati, Parolin, & Girelli, 2017). This was the first empirical study that provides support for the clinical hypothesis that the past and future are perceived differently by individuals with anxiety traits compared to people with depressive traits. This can help to inform psychological practitioners when providing interventions for people with anxiety and depressive symptoms by helping them to think about the actual distance in time of life events. A limitation to this study comes from not exploring how the perception of psychological distance may differ in anxiety and depression depending on the severity of the event that is imagined. Specifically, not asking participants to imagine themselves in a negative versus positive future and past event, can be seen as a limitation to this study. However, this study may present a positive starting point in a very new area of research.

In relation to this, a recent study by Siedlecka, Capper and Denson (2015) investigated temporal psychological distance (i.e., the subjective judgment of distance in time or space or, in other words, how near or far an event feels from the present moment) in relation to the intensity of an emotional event. In the first study the links between anger and guilty rumination on past experiences to the perception of temporal psychological distance. Specifically, participants were asked to recall a time when they felt angry and/or guilty when going food shopping in the last year. Participants were then asked how often they thought about this event, how they felt and what their perception was of temporal

distance. The Positive and Negative Affect Schedule (PANAS) was used to report feelings at the time of the scenario. The temporal distance was measured by using three questions. The first question asked participants how close or far away the event felt to them rating between 1, ‘very close’, to 7, ‘feels very far away’. The second question asked how long ago in time the event felt, rating 1 as ‘very recent’ to 7, ‘feels very long ago’. Finally, they were asked how near or distant in time the event felt, rating 1 ‘as very near’ to 7, ‘feels very distant’. The results showed that when people experience negative emotions such as anger, guilt and sadness, which then leads to rumination, they experience reduced temporal psychological distance (i.e., they perceive the past event as if it were yesterday where in fact it happened further away in the past).

This has clinical implications, for instance when people experience guilt for surviving a car crash when others in the car have died. The guilty rumination keeps the memory very vivid, which hinders recovery. Therefore, gaining better understanding of the relationship between memory and temporal psychological distance in negative life events can be beneficial for clients with trauma, anxiety and/or depression. A limitation of this study comes from not yet knowing the direction of the effect (i.e., whether individuals might ruminate about negative life scenarios because they have reduced temporal psychological distance or, in other words, because they feel closer to the past).

Psychologists have begun to understand the interdependence of space and time (Uttal, 2014). It has been shown that mental time travel can be stimulated by either a physical sense of movement or an imaginary one (Boroditsky & Ramscar, 2002; Caruso et al., 2013; Miles, Nind, & McRae, 2010). Furthermore, the recall of a scenario encompasses episodic recollection of a particular context such as environmental and emotional states. Specifically, a large body of research has shown that the ability to recall stimuli correctly depends not only on replicating the environmental conditions at encoding and retrieval (Morris et al., 1977; Tulving & Thompson, 1973) but also restoring encoding operations as retrieval improves episodic memory (Dewhurst, Conway, & Brandt, 2009).

Review on context for memory retrieval

During retrieval, the individual is searching for target memory, which in the present study would be the part of the experiment where participants were asked to recall the words they learned in any order. In relation to this, one needs to use retrieval cues for accessing the memory. Retrieval cues refer to small part of information that allows the individual to access the memory. For example: in the current study, the retrieval cue would be being asked to recall memory from today. Therefore, retrieval is a succession from one or more retrieval cues to a target memory. Cues help to retrieve memory because associations link memories to one another. This means that retrieval is a progression from one or more cues to target memory via associations (Baddeley et al., 2010). Following this idea, if the target memory receives a sufficient amount of activation from the retrieval cues, the memory will be retrieved. Retrieval does not occur if the individual does not attend to the cues. For example: in the current study if a participant does not attend to the cues at all or does not invest enough attention in the cues (e.g. remembering the situation where they were attending to the words and tried to remember them) then retrieval would not be successful. This idea is supported in a study that asked participants to recall words whilst at the same time making judgements about different items being shown on a screen. This resulted in an impaired retrieval rate compared to controls who were asked to recall the words without doing an additional task (Moscovitch & Westmacott, 2003). It would follow that dividing attention is likely to reduce retrieval success.

An important, well-established concept in the study of memory is the *encoding specificity* principle, which refers to the idea that for a retrieval cue to be helpful in retrieving memory, it needs to be present at encoding. Or, in other words, the more similar the cues at retrieval to the cues presented at encoding the higher the recall. One classic experiment on context-dependent memory presented participants with a list of sentences including either ‘the man lifted the piano’ or ‘the man tuned the piano’. After a 3 minutes’ break, participants were given cues such as ‘something heavy’. They were then asked to write all the nouns from the presented sentences in relation to each cue. Results have shown that ‘something heavy’ was a useful cue when *piano* was encoded in the context of lifting a piano but not when it was tuned (Barclay, Bransford, Franks, McCarrell, & Nitsch, 1974). These findings reflect the idea of encoding specificity hypothesis as only information that was involved at encoding left a memory trace meaning that only cues that are relevant to this information would be helpful for their retrieval. Research suggests that cues are important for facilitating recall. In one study participants were presented with target words, which they were later asked to recall. Each word was presented with a cue

that had a weak association to it (for example, chair and glue). After encoding, participants were asked to recall the words helped by the cue words, which were presented, with the target words. Other, control participants, were not shown the cue words. Results have shown that cue words significantly increased the recall of target words (Tulving & Osler, 1968) and this has been replicated in recent studies (Tulving, 2014; Hunt, Smith, & Toth, 2016). This study further showed that despite the logical association between table and chair, participants who were shown the target word chair and cue word glue had higher recall rate when shown the cue word *glue* compared to *table*. This suggests that it is the cue word that is associated with the target word at encoding stage that is powerful and significant for retrieval and not the obvious associated word (Tulving & Thomson, 1973).

Retrieval would not be facilitated if cues were weak despite being relevant. It is the strength of association of one memory to others that influence the activation that spreads between cue and target memory, which then lead enables the memory to be retrieved. Research suggests that incorporating duel cuing such as semantic and rhyme cues improved recall rates compared to the control group who received no cues (Rubin & Wallace, 1989). Furthermore, it can be argued that recall is based on our perspective of the situation. For example, in one study participants were asked to recall the items of a house from the perspective of a home buyer versus a burglar. Results have shown that participants recalled more words relevant to the perspective they adopted (Anderson & Pritchert, 1978). This means that one's perspective provides a structure or a schema that influences retrieval leading to retrieval of things that are relevant to the schema. Following on from the current study, future studies might ask participants who are high on anxiety trait to recall words from the perspective of someone who experiences an emergency situation, such as being injured in an accident. This would be compared to participants with low anxiety trait, who would be asked to adopt a neutral perspective such as asking them to recall words from the perspective of a person sitting on a bench in a leafy park, which might lead to different recall rates.

Additionally, the strength of encoding is important (Baddeley et al., 2010). This means that even with a relevant cue, the target memory might not be retrieved because of weakly encoded initial memory. Words vary with the frequency of their use. For example, 'meal' is more frequent than 'helmet'. Higher frequency words seem to be better recalled (Baddeley et al., 2010). A possible explanation for this is that words that are more frequent are better encoded due to their repeated exposure, which then leads to better recall. In relation to the current study, individuals with high anxiety might steer away from these words and have low exposure, which might then result in no significant difference in recall compared to individuals with low anxiety. Humans are surrounded by associations to the past;

nevertheless, they are not constantly reminded by memories, but only occasionally. Thus, it is suggested that in some instances, in order to be able to retrieve memories, one has to be in the right frame of mind or in the retrieval mode (Tulving, 1983). One study examined retrieval mode by measuring brain activity during retrieval. Participants learned list of words appearing on either the left or right-hand side of a computer screen. In the second part of the experiment they were shown the words mixed with new words and were requested to complete two tasks. The first task was to decide whether they had seen the word before and if so on which side of the computer screen.

The second task was to evaluate whether the word referred to an object that can move on its own such as buzzard. Participants' brain activity was recorded whilst they were making the evaluation which meant that the researchers could see if there was specific brain activity linked to getting ready for retrieval. Results show that there was greater brain activity in the frontal cortex, which is involved in attentional control, when participants were getting ready to retrieve (Herron & Wilding, 2006). This suggests that for effective retrieval it is important to ensure that words will be processed as probes of episodic memory. This also suggests that retrieval is improved by enabling participants to arrive at the right frame of mind, which is accomplished by the prefrontal cortex. In relation to the current study perhaps future research might record brain activity whilst administering vection-based intervention to examine if there was higher activity in the prefrontal cortex, which would mean that participants might be in retrieval mode, and thus improve retrieval performance.

Research has established that context cue is important for success of recall (Baddeley et al., 2010). The current study not only reproduced the context but also brought the participant back to the context by means of vection-based intervention, or in other words by inducing a sense of movement. Furthermore, the mood context of the encoding event is argued to be experienced as bringing participants back to the encoding stage which would thus elicit their mood at encoding. Explicit memory tests refer to memory tasks that overtly ask individuals to retrieve past events (Richardson-Klavehn, & Bjork, 1988). Free recall relies on context, since the task is to retrieve words in any order without any overt cues. Contrary to this, cued recall may for example provide an association of a previously studied word or the first letter of a word as a cue, thus recalling words in response to a cue. In the present study, the central idea was to test memory under the context in which it was encoded. This suggests that free recall is the best way to test it as it relies on context the most heavily.

Another type of direct memory test is the recognition test, which require the participant to state if they have encountered the stimulus before in the experiment, or not. This comes with clear limitations, as, for example, in eyewitness situations, where memory can prove inaccurate. The other way to test

memory is by using indirect memory tests, which test the memory without directly asking the participant to recall the past. For example, participants would first be presented with words and would later be presented with the previous words mixed with new words that are non-words (a string of letters with no meaning) asking them to decide which one is a real word (Baddeley, Eysenck, & Anderson, 2010).

This means that indirect tests require the individual to perform a task that on the face of it does not seem to be testing memory. Other ways to test memory indirectly are word-stem completion and the presentation of words briefly followed by a visual mask, and asking participants to say the word they saw. In conclusion, because indirect memory tests do not require recall of the past, context is not used as a cue meaning only cues such as the first letter of the word are used intentionally. One would expect recall performance to be lower than in direct memory tests because of the absence of context cues. However, recent exposure to the stimulus as part of indirect memory tests appears to improve performance, which is called *repetition priming* (Ochsner, Chiu, & Schacter, 1998). In the current study, bringing back the participant to the context of encoding, to check for recall performance as a comparison between low and high anxiety states, is the key idea of the study. Thus, context-dependent memory, which means bringing back the participant to the environment and mood they experienced in encoding, is central to the current study. This is because returning to the original environment reinstates the spatial context in which the event was originally encoded, thus aiding retrieval (Godden & Baddeley, 1975). With these findings in mind, indirect measures, specifically free recall, have been employed.

In one experiment, divers listened to words on the beach and underwater and were asked to recall them in the same environment versus the other one. Results have shown that stimuli learned underwater were better recalled underwater and stimuli learned on the beach were better recalled on the beach (Godden & Baddeley, 1975). This shows that context dependent memory indeed occurs. A more recent study asked participants to learn and recall words in the same room compared to participants who were moved to a different room at retrieval. Results have shown that the context change reduced the recall in that group asked to recall the words in a different room from where they encoded the words, compared to the group that stayed in the same room throughout the experiment (Aslan, Samenieh, Staudigl, & Bäuml, 2010). This would suggest that changing the environment context at encoding impacts on episodic memory. Furthermore, a review on context dependent memory suggested that individuals need to pay attention to the physical environment during encoding (Smith & vela, 2001). Specifically, it was suggested that focus of attention during encoding reduces or eliminates any incidental context effects and increases retrieval success. An example for the importance of incidental context effects is state dependent memory, such as the influence of drugs on memory. In one

study, heavy drinkers were asked to hide money whilst they were classified as drunk. Once sober, they could not remember where they had hidden the money. However, when they were drunk again, they were able to remember where they had hidden it (Goodwin et al., 1969).

This finding is seen only when memory is tested by recall (Eich, 1980), as in recognition tests search is not necessary. In another study, participants learned a list of words whilst resting on a cycling bike, versus pedalling on an exercise bike. Results showed that individuals who recalled the words in the same physiological state recalled 20% more words than participants who did not reinstate the episodic context (Miles & Hardman, 1998). These results demonstrate that aspects of our physiological state are encoded incidentally at encoding stage and re-creation of these aspects in retrieval assists memory. A recent study has shown that backward vection improved recall of neutral words (Aksentijevic, 2017). Thus, in the current study bringing back the participant to the encoding stage via the use of vection-based intervention was thought likely to assist memory.

Summary

It could indeed be expected that a preferential attention towards threat (i.e., hypervigilance) characterising anxiety (Eysenck, 1992) would lead to better memory performance (Coles & Heimberg, 2002). Nevertheless, avoidance, a central component in anxiety, may lead anxious individuals to escape the deep processing of threat-relevant information, which serves to decrease memory for threat by reducing the amount of encoding or limiting the retrieval of threat-relevant information (White, Ratcliff & Vasey, 2015). The theory proposed by Williams et al. (1988, 1997) seems to reconcile the conflicting views of some authors who suggest that anxious people are hypervigilant towards threat-relevant stimuli while others propose that anxious people avoid threat-relevant stimuli. This integrated view posits that anxious people tend to direct their attention towards threat-relevant stimuli during early, automatic processing stages. However, at later, and more strategic stages of processing, anxious individuals tend to direct their attention away from threat. The attention toward threat-relevant information would heighten the anxiety of the individual. However, this would be followed by the avoidance of threat-relevant stimuli, preventing the more elaborated evaluation process that could potentially reduce the perceived danger in the threat and lead to reduced anxiety (Bar-Haim et al., 2007).

Another important theory, which supports the current study, is Bower's (1981). This suggests that the current mood of an individual affects his or her ability to encode and retrieve information. It can be argued that memories are stored in different locations according to the individual's current emotional state. This theory suggests that in order to retrieve a memory, one has to access the same mood as experienced when encoding the memory. In respect of anxiety, according to Bower (1981), anxious individuals need to be anxious both at encoding and at retrieval stages if they are to recall more threat-related words. Following this, it can be argued that high-anxious individuals would experience anxiety when presented with threat-related words at encoding. Later, when mentally reminded of the encoding stage, they could access their original anxious mood, which served to facilitate recall. This process might help anxious people re-experience the anxiety felt when they were initially reading the threat words, thereby accessing their mood at the point of encoding the memory. Therefore, a memory bias may be seen in the process of backward motion, as this mentally replicates the encoding process. However, it is not possible to predict whether the memory bias would be away from the threat, where avoidance would play a key role. In this case, the recall of threat-related rather than neutral words would not be higher in anxious individuals compared to the low anxious, or vice-versa. If the memory bias is *away from* threatening material it would be expected to result in a lower recall of threat words in the

high-trait anxious compared to the low anxious. If, however, the bias is *towards* threat-related material, a higher recall of threat words would be expected in high-trait anxious compared to low anxious persons. Furthermore, it is well established in memory research that contextual cues are important for both the quality and the quantity of recall (Klein, 2015).

Based on the importance of context for recall, a recent study sought to reinstate participants to the point of encoding (Aksentijevic, 2017). This was achieved through *vection*, the process of inducing a perception or sensation of movement by watching a video of a train moving backward or forward; or through viewing film of the random flight of birds. Participants who had learned neutral words at the encoding stage, were asked to try and remember them and to recall the words following the vection-based intervention. The underlying hypothesis was that backward vection would bring the participant closer to the encoding context, thus facilitating recall. Results show that participants who experienced backward vection recalled more words than participants who experienced forward vection or random motion (Aksentijevic, 2017). This reveals that contextual cues can be evoked by means of vection based intervention.

In previous research this process has been tested by reproducing at the time of recall the original context present at the time of encoding. However, only one study attempted to bring participants mentally back to the point of encoding using vection-based intervention. The subsequent results showed higher recall of words for participants who experienced backward vection compared to forward vection and random vection (random movement). It was suggested that the backward vection brought participants closer to the encoding context thus facilitating recall (Aksentijevic, 2017). The study did not test the role of anxiety in relation to recall, when individuals are given vection-based intervention. This has led the present study to explore whether vection-based intervention would influence the recall of threat words in high-trait anxious compared to low anxious individuals.

Analytical Synthesis

This study is the first experiment to test if vection based intervention can reveal any memory bias in high-trait anxious individuals. It is important to highlight that there is tension with regards to being able to predict the direction of the current experiment results since threat related words could lead to having a strong imprint on memory, which might mean that it is easier to retrieve these words. However, at the same time emotional words can induce anxiety, which would mean that the individual's focus is narrow and thus it might be difficult to retrieve the information. Therefore, this study is *exploratory* and the rationale for it is based on the following literature:

Bower (1987) proposed that memories are stored in different locations according to mood the individual is experiencing. Thus, in order to retrieve memory, one has to access the same mood experienced at encoding (mood congruent recall). A limitation to this theory comes from not discriminating between explicit memory (consciously recalled) and implicit memory (unintentionally recalled). Another influential theory proposed by Williams et al. (1997) suggest that high-trait anxious tend to direct their attention towards threatening stimuli during early, automatic processing stages, which will heighten their anxiety. At a later stage of the processing high-trait anxious direct their attention away from threat, which means that they avoid it and thus a more elaborated, objective and deep processing of the threatening stimuli is prevented from taking place. A limitation to this model is that it does not specify how long it takes for high-trait anxious to move from direction attention towards the threat related stimuli versus directing attention away from the threat related stimuli. Intuitively, one would think that this is a very rapid process.

Boroditsky and Ramscar (2002) had shown that spatial movement affects our perception of time. Specifically, participants reported feeling moving with time when they experienced sensation of movement (imaginary). Thus, research uses movement through space in order to study time. Given that mental time travel can be induced by physical and imaginary motion (e.g. Boroditsky & Ramscar, 2002) and vection (Caruso et al., 2013, study 3; Miles, Nind & McRae, 2010), any of these methods could be used to take a participant "back" to the moment of encoding. In the current experiment vection based intervention was used. Additionally, Caruso et al. (2013) suggested that all humans have the tendency to view the future as closer than the past. This is because we perceive the future as approaching us whilst the past receding from us. It was shown that this tendency is amplified in high-trait anxious (Rinaldi et al., 2017). Moreover, Miles et al. (2010) showed that the sensation of moving forward led individuals to think more about the future whereas backward vection led them to think more about the

past. This suggests that perceived movement across space is linked to perceived movement across time. Perhaps vection can help high-trait anxious to objectively evaluate the distance into the future, which may affect the tendency to catastrophize future events and thus reduce anxiety.

Another central idea, which the current study is based on, is the notion of context dependent memory. This refers to the well-known principle that returning to the original environment reinstates the spatial context in which the event was originally encoded thus aiding retrieval (Goddon & Baddeley, 1975). Specifically, it was shown that divers who learned words under water versus on a beach were better able to recall these words if the learning place and retrieval place was the same (Goddon & Baddeley, 1975).

Furthermore, a recent manuscript in preparation had showed that backward vection enhanced recall of neutral words (Aksentijevic, 2017). Specifically, it has shown that backward vection led to higher recall of neutral words in comparison to forward vection (videos) or random motion. This suggests that backward vection brought participants back in time psychologically to the moment of encoding thus re-instating context dependent memory and aiding retrieval. To summarise, the current experiment is exploratory by nature and it is hoped that backward vection would bring participants back to the moment of encoding by accessing the anxiety they might have felt at encoding, when presented with threatening words thus reinstating specific context dependent memory (mood congruent recall). Thus, this might counteract the avoidance and consequently lead to better memory for threat words in high-trait anxious essentially by enabling high-trait anxious to objectively evaluate threat related stimuli.

Methods

Overview

The current study was approved by the departmental ethics committee and was carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki. This study aimed to examine whether motion manipulation affected how anxious (i.e., high-trait anxiety) participants perceive threat words. This question was investigated using a 3 x 2 between-subjects design on the number of remembered threat words. There are two independent variables (a. motion condition- forward, backward and no motion and b. trait anxiety group-high and low). There are two dependent variables: number of correct words and number of threat words. Furthermore, the STAI anxiety questionnaire state component was administrated both at the beginning and at the end of the experiment to check if participants' current anxiety state changed during the experiment. Furthermore, the STAI anxiety questionnaire trait component was administrated once at the beginning of the experiment. This required a within-subjects t test and was not part of the main analysis.

Hypothesis

Recent study has shown that backward vection improves recall of neutral words (Aksentijevic, 2017). The aim of this study is to explore whether vection affects recall of threat related words in individuals with high trait anxiety. However, it was not possible to predict whether the memory bias would be away from the threat (i.e. later stage processing influence this) or towards the threat-relevant words (i.e. episodic cues strengthen the initial attentional bias towards threat-relevant words). If the bias was away from threatening material it would have been expected to see lower recall of threat words in high-trait anxious compared to low anxiety condition. If, however, the bias was towards threat related material it would have been expected to see higher recall of threat words in high-trait anxious compared to low anxiety condition.

Participants.

Ninety undergraduate students took part in the study. The majority of the sample was female (n = 85; 94.4%). The ages of the participants ranged from 18 years to 53 years (M = 20.44, SD = 5.39). An a priori power analysis using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that the sample of 90 was sufficient to detect large effects (f = .40) at p = .005 with a power of .80. Participants were recruited through the online booking system or through personal contact and were

offered course credits for their participation. Three participants were distinctly older than the rest of the sample (43, 46 and 53 years). Fifty-nine participants (65.6%) had English as their first language. All participants had normal or corrected-to-normal vision and all provided informed consent and received credits for taking part in the study. Participants were assigned to three motion direction groups (forward, backward and no motion). It should be noted that it was not possible to randomly assign participants due to the repeated state component of the anxiety questionnaire. However, a list whereby it was indicated how many participants were allocated to each motion direction group was used to maintain balance among the groups in terms of age, gender and EFL (Bhat, 2001). Furthermore, at the end of the experiment participants were allocated into high and low anxiety groups using median split.

Design. A 3 x 2 between-subject design was used with two independent variables: a. motion with three levels: forward, backward and no motion and b. trait anxiety with two levels—high and low anxiety.

Materials and apparatus. The Spielberger trait anxiety questionnaire (STAI) scale, (Spielberger, 1983) was used to assess trait and state anxiety. This is a self-report questionnaire, which has two components: state and trait anxiety. Specifically, the state is designed to measure anxiety 'right now' (Julian, 2011). It contains items that measure feelings of tension and worry and includes items such as: ''I feel strained'' and ''I am worried''. By contrast, the trait component measures relatively stable characteristics of anxiety and contains items such as: ''I worry too much over something that doesn't really matter'' and ''I feel nervous and restless''. The STAI questionnaire has a test-retest reliability range between 0.68 and 0.77. It also has internal consistency with Cronbach's alpha of about 0.9 in both males and females (Waldhauser, Johansson, Backstrom, & Mecklinger, 2011). The STAI has 40 items, 20 items in each sub scale. Responses for the state component range from 1) not at all, 2) somewhat, 3) moderately so, and 4) very much so. Furthermore, responses for the trait anxiety scale range from 1) almost never, 2) sometimes, 3) often, and 4) almost always. This questionnaire was administrated with pen and paper. In terms of scoring, items were added in order to get a total score including reverse worded items, which represent the absence of anxiety such as 'I am happy'. Scores for each sub scale can range from 20-80, with the higher score signifying higher anxiety. Participants were asked to fill in both trait and state components of the STAI at the beginning of the experiment. However, at the end of the experiment they were asked to fill in only the state component in order to monitor whether their anxiety increased because of the experiment. For use in the analyses, a median split was performed on these scores to split the sample into high trait versus low trait.

Participants were presented with a list of 20 words, containing 10 threatening and 10 neutral words (Maddock et al., 2003) using slides on Microsoft Power Point (Microsoft Inc.) presentation software. The words were rendered in black lower-case Arial font (size 44) on a white background and were centered on the screen. The threat-related words were: “terror”, “victim”, “injury”, “cancer”, “panic”, “dangerous”, “threatening”, “emergency”, “violence”, and “destroyed”. Furthermore, the neutral words (matched for length and frequency) were: “detect”, “locate”, “track”, “border”, “margin”, “measurement”, “impression”, “pertinent”, “arrangement” and “translation”. Each word was presented for two seconds followed by a two-second random pattern mask. The word order was quasi-random so that threat and neutral words were mixed. Participants were asked to concentrate and try and remember as many words as they could.

Scores on the trait scale can range from 20-80. In the current data, the scores ranged from 23 to 75. The median value of the current sample is 41 (*M* = 43.74*, SD* = 11.64), which is close to the value often found in research findings that include trait anxiety in their analysis (Miller, Few, & Widiger, 2012: Few et al., 2016). Following the median split, 46 participants were assigned to the low anxiety group and 44 to the high anxiety group. For the purposes of additional analyses a quartile split was also conducted on the trait scores. Quartile 1 ranged from 23-35, quartile2 ranged from 36-41, quartile 3 ranged from 42-52 and quartile 4 ranged from 53-75. Therefore, quartile 1 refers to very low trait anxiety, quartile 2 refers to low trait anxiety, quartile 3 refers to high-trait anxiety and quartile 4 refers to very high-trait anxiety. Following the quartile spilt 25 participants were assigned to very low trait anxiety group (quartile 1) and 21 participants were assigned to low trait anxiety group (quartile2) 23 participants were assigned to high trait anxiety group (quartile 3) and 21 participants were assigned to very high trait anxiety group (quartile 4).

Motion videos depicting forward or backward motion were presented on a PC computer running Windows 7. These were created as follows: A video clip was recorded from inside the last car of a train giving a strong impression of backward motion (visual angle 26.72 x 18.46 degrees). The video was edited using Adobe Premier software (Adobe Inc.) and a two-minutes video was extracted to which a 1-second fade-in and fade-out ramps were added. Sound (train motion—no voices) was normalized and the video extract was saved in .avi format. Reversing the original clip created the forward-motion version.

Procedure. The experiment was carried out in a dedicated student research room in the Department of Psychology at the University of Roehampton. Artificial lighting was used during the experiment apart from when the participants watched the motion video. At the start of each session, participants were briefed and asked to sign a consent form. Following this, they were asked to generate a unique number that was used to link their details to their data. This number was written on the consent and debriefs forms. Then, participants were asked to fill in a demographics questionnaire and both state and trait components of the Spielberger trait anxiety questionnaire (STAI) scale, (Spielberger, 1983). This took no longer than ten minutes. Next, participants were asked to view the words and to try to remember them. This has taken about 2 minutes. Specifically, the first slide of the presentation stated: "You will now see a list of words. Please concentrate and try to remember as many as you can. Click on the mouse to start." The last slide stated: "Thank you, this is the end of the presentation''. Following this, participants were asked to spend ten minutes solving pen and paper average medium difficulty Sudoku puzzles as a distractor task taken from (printable-sudoku-puzzles.com). Then participants were shown a video of either a train moving forward, backward with the following instructions: ''You are now going to see a short video of a train journey. Please concentrate.'' The participants in the control group were not shown a video and were asked to continue with Sudoku puzzles for another two minutes. The artificial light was turned off during the video presentation. Following the videos, all subjects were asked to write down as many words as they could remember in any order on a piece of paper within two minutes. Then, all participants were asked to complete a state component of STAI again. Finally, participants were debriefed. This stage took between five to ten minutes and the whole session lasted approximately 45 minutes.

Results

Descriptive statistics

The means and standard deviations for all the study variables are presented in table 1. Participants could have recalled up to 10 threat words, as can be seen in table 1 the mean number of threat words recalled is 4.10. Thus, on the whole the participants in the sample recalled low number of words.

Table 1. All the means/SDs of all of the study variables

Variable	*M*	*SD*
Age	20.40	5.4
Vision	1.00	.00
Motion	2.00	.82
Total Words recalled	8.70	2.88
Number of threat words recalled	4.10	1.74
State one total	39.70	12.47
State two total	39.60	10.91
Trait total	43.70	11.64

Note. N=90, *M*=mean, *SD*=standard deviation

Exploratory Data Analysis

An independent samples *t*-test compared English versus non-English speakers on the number of threat words. Leven's test for equality of variances revealed that the assumption of equal variances had been met, $F = .24$, $p > .05$. The t-test revealed no significant difference between the groups, $t(88) = .05$, $p > .05$. Furthermore, in order to test whether participants' anxiety level changed during the experiment a paired samples t-test was carried out on pre- and post-test STAI scores, revealing no significant difference, $t = 0.11$, $p > .05$. Furthermore, looking at the whole sample participants were slightly on the higher end of the anxiety scale versus the lower scale ($M = 43.74$). In relation to this, the range of scores for the state component of the STAI as well as the trait component of the STAI is 20-80 (Julian,

2011) with higher score suggesting greater anxiety. For the present data, participants' scores ranged from 20-78 for State 1, and 20-68 for State 2. The average state score at Time 1 (before the experiment) is 39.74 (*SD* = 12.47); the average state score at Time 2 (after the experiment) is 39.63 (*SD*=10.91).

Furthermore, A two 3x2 between-subjects ANOVAs were conducted looking at the impact (and the interaction between) the different motion groups (forward, backward, no motion) and trait anxiety (high versus low), calculated by a median split on each of the following variables: 1) Total number of threat words recalled 2) Total number of words recalled. The first 3x2 ANOVA (forward, backward, no motion x high and low anxious) was conducted on the number of threat words recalled. There was no significant difference between the trait groups on the number of threat words recalled, $F(1, 84) = 1.75$, $p > .05$. There was no significant difference between the three motion groups on the number of threat words recalled, $F(2, 84) = 1.55$, $p > .05$. Thus, there were no significant main effects from this ANOVA. In addition, there was no significant interaction between the two variables (i.e., the three motion groups interacting with the two levels of anxiety) on the number of threat words recalled, $F(2, 84) = 1.31$, $p > .05$. As such, no further post-hoc tests were required. The means and standard deviations for these variables are presented in table 2.

Table 2. Number of threat words recalled

Trait group	Motion	*M*	*SD*	N
Low trait	Forward motion	3.48	1.62	17
	Backward motion	4.00	1.67	14
	No motion	4.07	1.58	15
	Total	3.80	1.60	46
High trait	Forward motion	4.23	2.28	13
	Backward motion	3.76	1.61	16
	No motion	5.20	1.48	15
	Total	4.39	1.86	44
Total	Forward motion	3.80	1.93	30
	Backward motion	3.87	1.61	30
	No motion	4.63	1.60	30
	Total	4.10	1.74	90

Note. M=mean, *SD*=standard deviation, N=number of participants

The second 3x2 ANOVA tested the differences between low and high-trait anxious exposed to the various motion groups on the total of number of words recalled. There was no significant difference between the trait groups on total number of words recalled, $F(1,84) = .76$, $p > .05$. There was no significant difference between the three motion groups on the total number of words recalled, $F(2, 84) = 1.49$, $p > .05$. Thus, there were no significant main effects from this ANOVA. In addition, there was no significant interaction between the two variables (i.e., the three motion groups interacting with the two levels of anxiety) on the total number of words recalled, $F(2, 84) = .15$, $p > .05$. As such, no further post-hoc tests were required. The means and standard deviations for these variables are presented in table 3.

Table 3. *Total words recalled by the various motion groups*

Trait group	Motion	*M*	*SD*	N
Low trait	Forward motion	7.88	2.70	17
	Backward motion	8.43	3.32	14
	No motion	9.00	1.41	15
	Total	8.41	2.57	46
High trait	Forward motion	8.53	3.73	13
	Backward motion	8.50	2.99	16
	No motion	9.87	2.83	15
	Total	8.98	3.20	44
Total	Forward motion	8.17	3.14	30
	Backward motion	8.47	3.10	30
	No motion	9.43	2.23	30
	Total	8.70	2.88	90

Note. M=mean, *SD*=standard deviation, N=number of participants

For the purposes of additional analyses a quartile split was also conducted and thus a further two 3x4 between-subjects ANOVAs were conducted looking at the impact (and the interaction between) the different motion groups (forward, backward, no motion) and trait anxiety (high versus low) on each of the following variables: 1) number of threat words recalled 2) Total number of words recalled 3) state anxiety scores (pre and post experiment state scores). As mentioned earlier Quartile 1 ranged from 23-35, quartile 2 ranged from 36-41, quartile 3 ranged from 42-52 and quartile 4 ranged from 53-75. Therefore, quartile 1 refers to very low trait anxiety, quartile 2 refers to low trait anxiety, quartile 3 refers to high-trait anxiety and quartile 4 refers to very high-trait anxiety. Following the quartile spilt 25 participants were assigned to very low trait anxiety group (quartile 1) 21 participants were assigned to low trait anxiety group (quartile 2) 23 participants were assigned to high trait anxiety group (quartile 3)

and 21 participants were assigned to very high trait anxiety group (quartile 4). The first 3x4 ANOVA tested the differences between the quartile trait anxiety group exposed to the various motion groups on the number of threat words recalled. There was no significant main effect for trait (quartile group), $F(3, 78) = 1.94$, $p > .05$. There was no significant main effect for motion group $F(2, 78)= 1.60$, $p>.05$. There was no significant interaction between trait quartile group and motion group $F(6, 78)= .80$, $p>.05$. As such, no further post-hoc tests were required. The second 3x4 ANOVA tested the differences between the quartile trait anxiety group exposed to the various motion groups on the number of total of words recalled. There was no significant main effect for trait (quartile group), $F(3, 78)= 1.16$, $p >.05$. There was no significant main effect for motion group $F(2, 78)= 1.05$, $p>.05$. There was no significant interaction between trait quartile group and motion group $F(6, 78)=.40$, $p>.05$. As such, no further post-hoc tests were required. An additional focus was to look at the relationship between motion group and state anxiety. Specifically, a 3x2 mixed ANOVA was conducted in order to assess differences between pre and post state anxiety score, between the three motion groups and also to examine the interactions between motion groups and state anxiety. There was no significant main effect for state anxiety $F(1, 87)= .013$, $p >.05.$ There was no main effect of motion, $F(2, 87)= .660$, $p > .05$. There was no interaction between state anxiety and motion, $F(2, 87)= 1.910$, $p > .05$.

Discussion

Research findings coming from a review on memory bias in anxiety are inconclusive with some studies that show memory bias and some that do not (Mitte, 2008). More specifically, it also showed that clinical status was not significantly linked to effect sizes, indicating no qualitative difference in information processing between anxiety patients and non-diagnosed high-trait anxious persons (Mitte, 2008). This means that more research is needed to better understand the connection between memory bias and anxiety. Recent study showed that backward vection improved recall of neutral words (Aksentijevic, 2017). Thus, the current study aimed to get a better understanding on memory bias in anxiety by the exploration of whether vection-based intervention can lead to an improved memory for threat related material in people with high trait anxiety (i.e., sub clinical group). Specifically, this study wished to examine whether there were significant differences between the motion groups (forward, backward and no motion) on the number of correct threat words recalled. Furthermore, Initial vigilance to threat-relevant information followed by avoidance might prevent the objective evaluation of threatening material, which may allow threat-relevant information to continue to elicit anxiety in anxious individuals (Coles & Heimberg, 2002). Therefore, the present study was the first to examine whether a vection-based intervention can enhance the retrieval of threat-related words over and above that for neutral words, thereby counteracting the lack of deep encoding of threat-related words in anxious individuals. Moreover, Bower (1981, 1987) suggests that experiencing anxiety will activate emotion nodes congruent with anxious mood, which in turn will determine the type of events and behaviours individuals can recall. According to this view if participants were more anxious due to the experiment they might have been able to recall more threat words. In relation to this Williams et al.'s (1988, 1997) model contradicts Bower's idea that anxiety may be a result of mood-congruent biases in attention since anxious individuals might have decreased processing of threat-relevant material due to avoidance playing a central role in their anxiety. Thus, according to this view, it is suggested that anxious individuals avoid deep processing of threat related material, which should show impaired memory for threat-related information.

Additionally, Williams et al. (1988, 1997) proposed a model that seems to account for the conflicting views of some authors suggesting that anxious individuals are hyper vigilant toward threat-relevant stimuli whereas others propose that anxious individuals avoid threat-relevant stimuli. This model posits that anxious individuals tend to direct their attention toward threat-relevant stimuli during early, automatic processing stages. However, at later and more strategic stages of processing, anxious

individuals tend to direct their attention away from threat. The attention toward threat-relevant information would heighten the anxiety of the individual. However, this would be followed by avoidance of threat-relevant stimuli, which would prevent a more elaborated evaluation process that could potentially reduce the perceived danger in the threat and lead to reduced anxiety (Bar-Haim et al., 2007).

Possible reasons for non-significant findings

It is important to note that according to the theory by Williams et al. (1988, 1997), avoidance could not have played part in not having significant higher recall of threat related words in high-trait anxious compared to low anxious. This model posits that anxious people tend to direct their attention toward threat relevant stimuli during early, automatic processing stages. However, at later and more strategic stages of processing, anxious individuals tend to direct their attention away from threat. The attention toward threat-relevant information would heighten the anxiety of the individual. However, there was no increase in anxiety scores over the course of the current experiment. Specifically, the current experiment did not increase participants' anxiety, meaning that state anxiety score was not significantly higher after the experiment versus the beginning of the experiment, which was a desired outcome. Thus, this seems to suggest that avoidance did not play a role in the present study's findings.

Participants' state anxiety (anxiety right now) was measured both at the very beginning of the study and at the very end of the study. The aim of the study was to elicit anxiety in participants, such that their state two score would be higher than their state one score, since this was believed to be caused via the vection based intervention at retrieval stage. Specifically, being presented with threat related words might have increased participants' anxiety at the time of encoding reflecting the first stage of hyper vigilance towards threat related stimuli as proposed by Williams et al.'s (1988,1997). Furthermore, using backward vection was hoped to counteract the processing stage whereby high-trait anxious direct their attention away from threat words. It was hoped that backward vection would bring participants back in time to the moment of encoding (i.e., when they were presented with the threat related words) thus enabling them to access their anxious mood, which was present at encoding. With regards to this Bower's (1961) model propose that mood congruent recall facilitate better memory or in other words would have increased recall of threat words compared to low anxious.

A recent experiment showed that using a vection based intervention, thus inducing a sense of movement, would psychologically bring back participants to the moment of encoding, which should enable them to access previously avoided threat related material (Aksentijevic, 2017). A paired

samples t-test was used to compare state one anxiety with state two, to see whether or not differences between these means were significant over time. Interestingly, this finding was not significant in state anxiety over the course of this study. Furthermore, a two 3x2 between-subjects ANOVAs were conducted in order to examine the impact (and the interaction between) the different motion groups (forward, backward, no motion) and trait anxiety (high versus low), calculated by a median split on each of the following variables: 1) Total number of threat words recalled 2) Total number of words recalled. No significant difference was found.

Further analyses using quartile split and thus a further two 3x4 between-subjects ANOVAs were conducted looking at the impact (and the interaction between) the different motion groups (forward, backward, no motion) and trait anxiety (high versus low) on each of the four variables: 1) number of threat words recalled 2) Total number of words recalled 3) state anxiety scores (pre and post experiment state scores). No significant difference was found following the use of quartile split.

This could, for example, be due to methodological flaws such as individuals not paying enough attention when watching the video of train moving backward or forward. This could result in them not being immersed in the sensation of movement. If they were not immersed sufficiently in the vection-based intervention, then at retrieval stage they might not be able to access their anxious mood in relation to threat words. This would then lead to such participants not seeing an increase in recall of threat words in high-trait anxious compared to low anxious when experiencing vection-based intervention. For more information on this please see avenues for future research. Therefore, the anxiety levels of this group may not have been influenced by their environment as that was possibly being perceived as ‘neutral’. This was supported by the results of the paired samples t-tests whereby a significant increase in anxiety over time (i.e., the state scores) was not found.

Another possible reason for not having significant results could be the stimuli used in the current experiment. As described in methods section the use of words was used in previous research and contained of 10 threatening and 10 neutral words (Maddock et al., 2003). The threat-related words were: “terror”, “victim”, “injury”, “cancer”, “panic”, “dangerous”, “threatening”, “emergency”, “violence”, and “destroyed”. Furthermore, the neutral words (matched for length and frequency) were: “detect”, “locate”, “track”, “border”, “margin”, “measurement”, “impression”, “pertinent”, “arrangement” and “translation”. On reflection it is observed that the number of syllables in the above words was not matched. Also, individuals’ differences with regards to level of anxiety that can be experienced following different threat related words should be noted. Perhaps interviewing participants in order to learn which words are perceived as more anxiety provoking for them as an individual might be helpful for future

research in inducing anxiety.

An additional focus was to look at the relationship between motion group and state anxiety. Specifically, a 3x2 mixed ANOVA was conducted in order to assess differences between pre and post state anxiety score, between the three motion groups and also to examine the interactions between motion groups and state anxiety. There was no significant main effect for state anxiety. This might be explained due to the data indicating that state anxiety was not increased due to the experiment, resulting in no increase from state one (beginning of the experiment) to state two (end of the experiment). This may explain why there was no significant difference in the recall of threat words in high-trait anxious compared to low anxious individuals. The theoretical basis for the present study followed the previously described and well known phenomenon that reproducing the context experienced in encoding at the time of recall, facilitates better recall. It was also associated with Bower's (1981) model which suggested that one needs to access the mood individuals experienced at encoding at the time of recall in order to facilitate recall. It can be argued that high-trait anxious participants experienced anxiety when they were presented with threat related words at the encoding stage. Since the anxiety did not increase from the beginning of the experiment to the end of the experiment, it can be argued that high-trait anxious individuals were not able to access their anxiety at the recall stage, which in turn did not facilitate recall. However, despite these non-significant findings, the current study is the *first one* to test the effect of vection-based intervention on recall in anxiety.

It was particularly surprising that backward motion versus no motion and forward motion had no significant effects on recall, since Aksentijevic (2017) has shown that backward vection based intervention improved recall of words compared to forward vection and random vection. However, Aksentijevic (2017) did not test anxiety and did not use threat related material in his study. Several explanations could be given for the present study's non-significant results: it could be argued that not being able to increase participants' level of anxiety from the beginning of the experiment to the end of the experiment, meant that when they were mentally brought back to the context of encoding at the time of recall they were unable to access their anxious mood, since this was not increased over the course of the experiment; resulting in no differences in performance being found. There is a possibility that participants were not immersed sufficiently in the vection based intervention. This would mean that they were not mentally brought back to the encoding stage at the time of recall. Furthermore, the model by Eysenck et al. (2007) suggests that when individuals consider themselves to be experiencing threat and thus anxiety, they then allocate attention widely but not specifically to the task in hand. Consequently, they are likely to have reduced attentional control with regards to an ongoing task (Fox, Russo, &

George, 2005). It follows that according to this view, participants in the current experiment may have had reduced attentional control when coming to recall threat words. Research suggests that individuals with high trait anxiety, or in other words individuals who are prone to developing anxiety disorder, might generalise threat to both threat related stimuli and neutral stimuli (Dunsmoor, Åhs, & LaBar, 2011). Thus, it is possible that participants in the current study classified in their minds both threat words and neutral words as threatening. If this was the case, it would explain why despite being transported back to the moment of encoding via the vection based intervention (previously hypothesised to enable them to access the anxious mood created when encoding the threat words), an anxious mood was created for both threat and natural words because of a tendency to generalise across stimuli (Gazendam, Kamphuis, & Kindt, 2013; Sehlmeyer et al., 2011). The above hypotheses may provide an explanation for the non-difference in recall between the threat words and neutral words, as both were rendered as threatening. Perhaps future research could examine the role of intolerance to uncertainty in high-trait anxious individuals when exposed to vection based intervention. The Processing Efficiency Theory differentiated between accuracy of task performance and amount of resources invested (Eysenck & Calvo, 1992). In relation to this it is proposed that anxiety related thoughts which are not relevant to the task in hand weaken processing efficiency, whereas worry will cause the individual to be more alert and this will counterbalance the effect of anxiety. Again, this might explain why there was no significant difference in recall of threat words between high trait anxiety and low trait anxiety.

Implications of research findings

Research suggests that individuals actively retrieve good memories as a means of regulating negative mood (Josephson, Singer, & Salovey, 1996). Therefore, cognitive biases operating during the processing of, for example, a dangerous situation, along with the memory for that event, can influence the ability to regulate emotions. This can then lead to susceptibility to anxiety disorders (Joormann, Yoon, & Siemer, 2009). The conclusion is that cognitive biases, including memory bias, play a significant role in the onset, maintenance and recurrence of anxiety disorders (Tran, Joormann, & Hertel, 2011). Initial vigilance to threat-relevant information followed by avoidance might prevent the objective evaluation of threatening material, which may allow threat-relevant information to continue to elicit anxiety in anxious individuals (Coles & Heimberg, 2002). Thus, the use of vection-based intervention to facilitate recall in relation to anxiety seems to be an important new area of research. Specifically, gaining a better understanding of how a vection-based intervention can influence the retrieval of threat-relevant information, could lead to a better understanding of how to stop threat related material continuing to stress high-trait anxious individuals. A vection-based intervention enabling the individual to go back mentally in time to the encoding stage, could prevent avoidance and allow individuals to objectively evaluate the threatening material. Hopefully, this would lead to the realisation that the perceived threat was not as threatening as the individual first perceived it to be. Additionally, perhaps the preponderance of women could have influenced the non significant findings. Thus, future studies could benefit for using equal numbers of female and males participants.

Further considering practical implications for the current study, one very recent study shows that the usual tendency to perceive the future as psychologically closer than the past is amplified in individuals with high trait anxiety (Rinaldi, Locati, Parolin, & Girelli, 2017). Therefore, practitioners could benefit from drawing attention to the role of psychological distance in psychopathology research and theory. The findings from the current study might therefore have important clinical implications, in that interventions for managing anxiety could benefit from focusing more on ways to help high-trait anxious individuals to think about the actual temporal distance of events in time. As previously discussed, anxious individuals report viewing future events as more vivid and more likely to occur (Trope & Liberman, 2010). Consequently, anxious individuals may be helped by focusing on the actual distance of events in time in order to set more positive achievable goals regarding their future. In addition, backward movement has been found to reduce the common tendency for the future to be closer than the past (Caruso et al., 2013). In other words, vection appears mentally to relocate participants into the

past or the future. This can have potentially important implications for therapeutic interventions for anxiety disorders, such as reducing perceived catastrophic future events by making future seem less close than it is normally perceived. The specific contribution of the present study is that this is the first study to attempt to mentally bring back individuals to the encoding stage at the time of recall of threat related words, compared between high and low anxious individuals. As a consequence, other researchers could build upon these findings as well as taking account of the limitations of the present study (please see avenues for future research sub section).

Limitations of the study and avenues for future research

The present study found that participants' state anxiety score did not increase over the course of the experiment. Following the model by Bower (1981), it is important that anxiety should increase in order for participants to access their anxious mood in relation to threat related material, when encoding and at the time of recall. Therefore, based on this limitation, future research could benefit from methods to induce more anxiety in participants, for example by showing them a distressing video whilst they try to memorise threat related words. Additionally, the whole sample seemed to be slightly more anxious that the range of scores indicated. Perhaps providing relaxation exercises at the beginning of the experiment could help to ensure a lower level of anxiety at the beginning of the experiment with the hope to increase anxiety at the experimental stage and thus to achieve a significant difference between state anxiety scores at the beginning of the experiment to the end of the experiment.

Lastly, the present study could not ensure that participants paid attention to the vection based intervention, with the result that perhaps they were not immersed sufficiently in that. Therefore, perhaps future research could benefit from checking immersion in the videos by using an eye-tracking device that records eye gaze and thus gives an indication of the level of immersion in the vection based intervention (Yasuda, 2015; Gordon & Hoedemaker, 2016). In additional to the eye tracking device, asking participants relevant questions after watching the video such as: 'What was the colour of the train?' could be helpful in checking whether they were fully concentrating and getting immersed in the vection-based intervention. Inducing more anxiety by using a distressing video, whilst showing the participants threat related words, could be helpful in order for the state anxiety scores to increase over the course of the experiment. This would mean that perhaps participants would be able to access their anxious mood experienced at encoding at the time of recall and this would be likely to facilitate higher recall of threat related words. Additionally, manipulating the type of videos shown, such as showing a different video to induce a sense of movement, as well as increasing the speed of movement and its duration, could perhaps elicit greater differences in recall performance. Finally, when embarking on the current research study it did not seem necessary to conduct a pilot study. However, on reflection a pilot study might have been beneficial in providing the researcher with valuable feedback.

Conclusion

In conclusion, the present study has examined for the first time the impact of vection based intervention on recall of threat related words versus neutral words in high-trait anxious participants compared to low anxious. Previous research has suggested that the perception of future events as being closer than past events appears to be exaggerated in high-trait anxious participants. Consequently, anxious individuals may be helped by focusing on the actual distance of events in time and in this way to set more positive achievable goals regarding their future. The present study is the *first study* in this area of research and therefore building on its findings, as well as its limitations in methodology, could help further research to better understand the role of anxiety in memory, when using vection based intervention.

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Appendices

Participant Number:

PARTICIPANT CONSENT FORM

Title of Research Project: The effects of induced motion on memory for words

Brief Description of Research Project, and What Participation Involves:

This study aims to investigate the effects of motion perception on memory. You will be presented with a list of words, and asked to memorise these. After a 10-minute interval you might be asked to watch a short video of a train journey. Finally, you will be asked to recall as many words as possible within two minutes. The participation should take no more than 45 minutes, and you will be accredited with 0.75 credits in return for your participation.

Data that is collected will be kept strictly confidential and anonymous, which means no participants' detail of identification will be recorded and would therefore mean it would not be possible to link the questionnaire that the participant provided. To make this possible, all participants will be assigned a code so that only you would be able to know. If you choose to withdraw at any stage (before, during or after the study has been completed), you will be able to by providing the investigator with your code number

Investigator Contact Details:

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Consent Statement:

I agree to take part in this research, and am aware that I am free to withdraw at any point without giving a reason, although if I do so I understand that my data might still be used in a collated form. I understand that the information I provide will be treated in confidence by the investigator and that my identity will be protected in the publication of any findings, and that data will be collected and processed in accordance with the Data Protection Act 1998 and with the University's Data Protection Policy.

Name ……

Signature ……

Date ……

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator (or if the researcher is a student you can also contact the Director of Studies.) However, if you would like to contact an independent party please contact the Head of Department.

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Participant Number:

PARTICIPANT DEBRIEF

Title of Research Project: Effects of induced motion on the recall of threatening words

Thank you very much for taking part in this study, we greatly appreciate your contribution.

Recent research has demonstrated that walking or imagining walking backwards improves memory for words. Similarly, word recall is improved if participants are asked to watch a video of backward motion (Aksentijevic et al., in preparation). Physical, imaginary or induced motion facilitates mental time travel which "transports" participants back to the time of encoding thus facilitating memory. The aim of the present experiment was to establish if watching a video of backward motion would improve the memory for threatening words. As this is often associated with levels of anxiety, we also measured your trait and state anxiety scores. If you would like to learn more about this research, please contact Dr Alex Aksentijevic (a.aksentijevic@roehampton.ac.uk).

All data gathered during this study will be held securely. You can withdraw from participation from the whole experiment or any part of it at any point without needing to justify your decision. You can also request for your data to be withdrawn at any time after participation in the study. In order to do this, please contact the investigator with your participant number. Please be aware, however, that data may still be used in a collated form. Finally, if you are a student who is volunteering for course credits as part of an undergraduate module, please be advised that there will be no adverse consequences in relation to assessment for your degree if you decide to withdraw.

Should you have any concern about any aspect of your participation in this study, please raise it with the investigator in the first instance, or with the Project Supervisor or Head of Psychology.

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Demographics Questionnaire

Participant number_____

Demographics questionnaire

Age (years, months):_____

Gender: Male

Female

I'd rather not say

Occupation: _____

Is English your first language? Yes No

If not, please state your first language: _____

If not, how long have you been speaking English (years)? _____

Is your vision normal or corrected-to-normal (glasses/lenses)? Yes No

STATE QUESTIONNAIRE

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right now,* that is, *at this moment in time.* There are no right and wrong answers. Do not spend too much time on each statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately	Very much
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self confident	1	2	3	4

12. I feel nervous	1	2	3	4
13. I am jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

TRAIT QUESTIONAIRE

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you GENERALLY feel. There are no right and wrong answers. Do not spend too much time on each statement but give the answer, which seems to describe you best.

	Not at all	Somewhat	Moderately	Very much
1. I feel pleasant	1	2	3	4
2. I feel nervous and restless	1	2	3	4
3. I feel satisfied with myself	1	2	3	4
4. I wish I could be as happy as others seem to be	1	2	3	4
5. I feel like a failure	1	2	3	4
6. I feel rested	1	2	3	4
7. I am 'cool, calm and collected'	1	2	3	4
8. I feel that the difficulties are piling up so that I cannot overcome them	1	2	3	4
9. I worry too much over something that doesn't really matter	1	2	3	4
10. I am happy	1	2	3	4
11. I have disturbing thoughts	1	2	3	4
12. I lack self-confidence	1	2	3	4
13. I feel secure	1	2	3	4
14. I make decisions easily	1	2	3	4
15. I feel inadequate	1	2	3	4
16. I am content	1	2	3	4

17. Some unimportant thoughts 1 2 3 4
run through my mind and bother me
18. I take disappointments so keenly 1 2 3 4
that I can't put them out of my mind
19. I am a steady person 1 2 3 4
20. I get in a state of tension or turnmoil as I think 1 2 3 4
Over recent concerns and interests

Ethical Committee Approval

The research for this project was submitted for ethics consideration under the reference PSYC 16/ 241 in the Department of Psychology and was approved under the procedures of the University of Roehampton's Ethics Committee on 20.10.16.